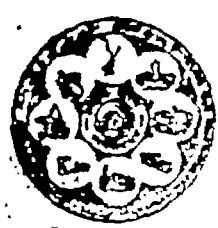
ALL-INDIA VILLAGE INDUSTRIES ASSOCIATION

What Shall We E

(Being a hand-book on Dietetics)

BY

JHAVERBHAI P. PATEL



Maganvadi,

WARDHA

1947

THE ALL-INDIA VILLAGE INDUSTRIES ASSOCIATION

What Shall We Eat?

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FOREWORD

BY

M. K. GANDHI

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FOREWORD

[TRANSLATED FROM THE ORIGINAL IN GUJARATI]

Sjt. Jhaverbhai is adding to his stock of knowledge by fresh studies. Naturally, he utilises his knowledge by broadcasting it to the public..... If he continues to do so he will make his knowledge into a common heritage for the people.

Sjt Jhaverbhai's composition is a fine essay. It aims at presenting the science of dietetics in easy language. I hope this will reach a large number of people and that the suggestions therein will be made use of by them. The purpose of the writer is to produce a practical and useful book and not an academic treatise.

Sewagram,
7-3-'45

M. K. Gandhi

PUBLISHER'S NOTE

"Man, know thyself" said an ancient philosopher. This trite saying has many facets to its interpretation. Man has to understand not only his higher self but also his own physical body and his environment and setting. One should have thought that man's body would command his attention first. Yet how little we know of it? Universities confer various degrees on its alumni but how many of these learned persons know how to look after their own bodies properly, feed it with adequate fuel, give it materials to repair the wastage, and provide it with protective forces to guard against the attacks of diseases? Our education is extremely defective and lacks balance in its approach to life and its problems.

To correct this defect in our elementary knowledge we are placing this book before the public. Sjt. Jhaverbhai P. Patel, in his own inimitable way, has shorn a technical subject of much of its phraseology and is presenting the subject to the lay reader in such a manner as to be useful in his everyday life. The rich in their ignorance indulge their palates with overcooked and ill-balanced food, while the poor, in their penury, cannot afford to add to their diet the more nutritive ingredients of a balanced diet. Hence both alike suffer from malnutrition. We trust the message of this book will bs instrumental in building up the wasted bodies of our people.

Maganvadi,
Wardha, C. P.

J. C. Kumarappa

INTRODUCTION

The main purpose of this book is to put available scientific information regarding nutrition in simple, untechnical language, so as to make it reach the ordinary layman. Scientific books on dietetics mainly discuss the principles of nutrition, or in a few cases such principles are applied to suit conditions in the West. Application of the newer knowledge of dietetics to conditions obtaining in our own country is seldom found. The present book is an attempt to meet this felt need.

Poverty and ignorance

Our starvation and malnutrition are commonly attributed to our poverty and ignorance. We have discussed this question in greater detail in Chapter X. We shall here take a few illustrations of the two causes.

We know, it is oxygen that keeps the lamp of our life burning bright. Nature freely provides oxygen. If we are not able to make use of this free gift of nature, it must be due to our stupidity. Physiology suggests that it is iron in the from of haemoglobin in the blood that draws Oxygen into the body from the air. If there is deficiency of iron in the body through malnutrition due to poverty, even the freshest air of a sanatorium is of no avail. This is an example of poverty making the lamp of life burn dim.

In the countryside the banks of rivers and ponds are ordinarily used as open lavatories. As a result the water of these places is injected with various kinds of disease germs. This water is often utilised for washing and drinking purposes and carries these germs into our body. These germs eat up the stock of iron in our blood. The result is the same

as in the case of deficient supply of iron through food. You may take enough of iron through food and you may enjoy the best of air, but all this will be exhausted by disease germs entering your body through impure water. This again is an example of our ignorance and stupidity.

Calcium is an important food factor in the formation of our body cells, particularly the bones and the teeth. But Calcium in the food, is not assimilated by the body in the absence of Vitamin D. In cities, and particularly in places where women observe "Pardha", though sufficient Calcium may be eaten, it is not utilised by the body because there is lack of Vitamin D through the sun. This again is attributable to our stupidity. Our village folk get enough of Vitamin D through the sun. But what use can they make of this Vitamin when they do not get enough of Calcium which is found only in costly articles of diet such as milk, fruits, and vegetables ? This is where poverty proves to be an obstacle.

Having adopted vegetarianism, our people have made a variety of experiments in the matter of food. Though no data in the way of present day chemical analysis of food factors may be available, our Ayurveda, based on the minutest observations of the effects of various foods upon the health and well-being of persons, provides a very valuable guide in the matter of food. The Western method, though giving the chemical analysis of food substances, does not go so far as to describe the ultimate effect of these substances upon our health. It may declare guava to contain Vitamin C and papayas to contain Vitamin A but does not go further; Ayurveda on the other hand declares guava to have a cooling effect and papayas a heating effect on the system. Both the sciences are incomplete in themselves and require to be supplemented by each other. Let us hope that a combination of the experience of the East and the knowledge of the West will bear fruit in this regard. The discussion that follows is bassed on the western method.

I have drawn freely from "Food" by Sir Robert Mc. Carrison, "Health and Nutrition in India" by Prof. N. Gangulee, and "Human Nutrition and Diet" by Dr. W. R. Aykroyd. My friend Dr. M. J. Trivedi has gone through the scientific portion of the book and has made many valuable suggestions. Finally, Gandhiji has also gone through the manuscript and has blessed the book with a Foreword.

Lastly, I cannot forget to express my gratitude to Dr. Bharatan Kumarappa whose editing hand can be seen in this, as in my other previous attempts.

Jhaverbhai P. Patel

CONTENTS

CHAPTER I.

WE ARE WHAT WE EAT

In terms of Ayurveda our body is formed of five main elements - earth, water, fire, air and space or ether.

We know that there is "space" in our stomach and other organs. Breathing in and out indicates the presence of air in the body. Nature has provided fire or heat in every living being. It is obvious that there is also water in the body. More than two-thirds of our body weight is made up of water. Earth may be taken to mean solid matter of vegetable and animal origin. Thus the main element that forms the body is the solid matter produced from the earth through the food we eat.

The nutritive contents of the food depends on the richness of the soil. Just as the elements in milk are extracted out of the body so also food elements are extracted out of the earth. If the earth is deficient in certain elements, the food produced from it will also be deficient in these elements. The soil in the Himalayan region is deficient in iodine and therefore iodine-deficiency diseases such as Goitre are more markedly prevalent in those parts. We often hear old people remark that present day grains do not taste sweet. This may mean that the grain produced today is deficient in certain elements because of impoverished soil. Owing to inadequate methods of cultivation, manuring and irrigation, our land has deteriorated and the result is the poor quality of grain product. Though, to all appearances, the grain may be the same as before, the constituent ingredients may be wanting. Modern scientists, therefore, speak of the

necessity of a "Marriage of health and agriculture" to emphasise the fact that improvement in agriculture is the foundation for improvement in health.

About the close relationship between our health and the condition of soil on which our foods are grown Sir Robert McCarrison observes, "Impoverishment of the soil leads to a whole train of evils. Pasture of poor quality, poor quality of the stock raised upon it, poor quality of the food stuffs they provide for man, poor quality of the vegetable foods that he cultivates for himself, and faulty nutrition with resultant disease in both man and beast. Out of the earth are we and the plants and animals that feed us created and to the earth we must return the things whereof we and they are made if it is to yield again foods of a quality suited to our needs."

"A fertile soil means healthy crops, healthy animals and last but not the least healthy human beings."

"Health is a whole. There is no separate human health, no separate animal, no saparate vegetable, no separate soil health and the way in which this whole can be got and maintained is that every living thing in it after its death should not be treated as waste but be returned to the soil. All dead animal and vegetable matter must be returned to the soil, so as to live again, if the whole or health of life is to be preserved. This is the first rule of life that gives to it wholeness, holiness and health."

(Indian Farming-May 1941)

Not only does impoverished soil produce foodstuffs of inferior quality, but it also draws harmful germs, bacteria and pests to the crops, which are not attacked in a healthy soil.

In passing, it may be mentioned that chemical manures are commonly talked of and earnestly recommended for the

improvement of our agriculture. We shall discuss this question in some detail in the tenth Chapter. Here it is enough to point out that these chemical manures do not enrich the soil, but act as a sort of purgative to the soil, thereby making the soil give out its elements in a concentrated form. This results in an immediate bumper harvest but leads to the ultimate impoverishment of the soil.

According to present day science, our body is made up of the following elements :—

Elements	Percentage of bodily weight
Oxygen	72.0
Carbon	13.5
Hydrogen	9.0
Nitrogen	2.5
Calcium	1.3
Phosphorus	1.2
Sulphur	0.15

In addition to these, sodium, chlorine, florine, potassium, iron, magnesium, and soilicon are also found in small quantities in the body.

At the Paris Exhibition in 1937 there was an interesting show case containing bottled specimens of the elements except florine, that make a human body in its correct proportion. It is estimated that " in the body of a woman of average size there are nine gallons of water, enough Oxygen to fill nine gallon barrels, enough carbon to make 9000 graphite pencils, enough phosphorus to make 8000 boxes of matches, enough hydrogen to inflate a balcon capable of raising the whole body to the top of Snowden, enough iron to make 5 tacks, enough salt to fill 6 ordinary salt cellars and 4 to 5 pounds of Nitrogen. "

The food which provides the above elements in their correct proportion can be said to supply the needs of the body. That is what is meant by " Balanced diet ". Nutrition experts prescribe balanced diets on the basis of these essential needs of the body, making due allowance for age, climate, nature of work, and such like.

Just as the body is composed of these elements in fixed proportions, so also food articles like grain, milk etc. are composed of the same elements in fixed proportions. Grain is also a sort of body. Therefore, balanced diet can only be planned by utilising the whole part of the grain. Utilising only a part of the grain and doing away with the rest through various kinds of processing of it does not provide all the ingredients necessary to the body and as such does not constitute a balanced diet.

Of the above elements Oxygen, Hydrogen and Nitrogen in their elementary form, are found in very small quantities in the body. They are in the form or various chemical compounds together with other elements. If Nitrogen is predominant in flesh, Calcium and Phosphorus are predominant in bones and teeth. Most of the iron in the body is concentrated in the blood, while sugar and fat are spread through out the body. Generally speaking, all elements are found in all parts of the body.

An idea of what constitutes a balanced diet may be obtained with the help of the tables given in the appendix and from the following formulae for different food elements.

1. Carbo - hydrates :

The simplest form of carbo-hydrates is glucose. The formula for glucose is C6 H12 O6 which means, it is composed of 6 parts of Carbon, 12 parts of Hydrogen and 6 parts of Oxygen. Glucose is a monosachharide. Cane-sugar is a

disachharide having the formula C 12 H22 O 11. Under certain favourable conditions, one molecule of cane-sugar can take up one molecule of water to give 2 molecules of monosachharides.

Cane-sugar Plus Water = Glucose Plus Fructose
C12 H22 O11 $H2_0$ C6 H12 O6 C6 H12 O6

Starch is a polisachharide. It does not dissolve in water. The saliva of the mouth dissolves it and converts it into maltose which again is a disachharide.

2. Fat

Oil, ghee, fat etc. are all forms of fat. They are all compounds of glycerol and fatty acids. They are made up as follows—

Glycerol = C3 H5 (OH)3

fatty acid, (say steavic acid) = C17 H35 CO OH

C3 H5(OH)3 3 C17H35 COOH—C57 H116 O_9 $3H_2O$

Comparing the composition of carbohydrates and fats we find that both are made of the same elements viz: Oxygen, Hydrogen and Carbon. The only difference is in the proportion of these elements. As compared to carbohydrates, fats contain very much less of Oxygen. If this is understood the conversion of carbohydrates into fat and vice versa in the body as discussed in the fifth chapter will be easily grasped. In the process of oxidation, the carbon of sugar, fat etc. is oxidised to carbon-di-oxide (C.O2) and the Hydrogen to water (H_2O). As fats contain less of Oxygen they require more of outside Oxygen for combustion. This is the reason why in the body fats keep burning longer than carbohydrates. In other words fats produce more heat in the body than carbohydrates.

3. Protein

During digestion protein breaks down into its simpler forms which are called amino acids. The average composition of amino acids in the body is as follows :—

Carbon	52%
Hydrogen	7
Oxygen	22
Nitrogen	16
Sulphur	2
Phosphorous	1

Protein contains Nitrogen, Sulphur and Phosphorous in addition to the elements contained in carbohydrates and fats. Without Nitrogen the body cells are not formed. This shows the importance of Protein to the body. The Nitrogen in the Protein is utilised in the cell-formation and the Carbon, Hydrogen and Oxygen elements are utilised in the body in the same way as carbohydrates or fats. But Nitrogen of all kinds of Protein is not utilised by the body, neither does the body utilises Nitrogen in excess of its requirements. All this extra or waste Nitrogen has to be discarded by the body in the form of urea. That means an extra strain on the kidney. If we remember this we shall understand the reason for not eating too much of protein or unassimilable protein or not taking protein for the production of energy instead of carbohydrates and fats.

In addition to these elements we get minerals mentioned in the table above from our food as well as water. Many of the mineral salts pass unchanged out of the body while some of them are utilised in the body for cell-formation, such as Calcium and Phosphorus to form bones and teeth.

On the one hand, the body receives the above elements from food and water, and on the other hand these elements are thrown out of the body in the form of waste products. It is said that in 7 years all the cells of the body will have given place to new ones, at least once and hence this can be looked upon as having built a new body in the place of

the old. After food is digested in the alimentary canal and absorbed in the blood and assimilated into the body cells, the waste products are thrown out of the body in three ways.

1. Through expiration,
2. Through perspiration,
3. Through urine.

The alimentary canal though situated in the body is a two open-mouthed pipe and as such is not considered part of the inside body. Therefore the faecal matter is a waste product of the food and not of the body.

We shall now consider the waste products of the body. Through expiration, water in the form of vapour and carbondioxide CO_2 are thrown out. Perspiration contains water, mineral salts and CO_2 and urine contains water, nitrogen etc. Thus with the waste products are thrown out Oxygen, Hydrogen, Nitrogen, Carbon and minerals. These have to be replaced from food and water again. How close is the relationship between body and food !

The following table shows the food substances and the end products of the body.

Table Illustrating the inter--relationship of the various digestive factors

Food substances	Where digestion takes place	Secretions assisting digestion	Form in which food substances are utilised.	End-products of metabolism
Carbo-hydrates	Mouth, stomach, small intestines	Saliva, pancreatic and intestinal secretions.	Glucose	CO_2 & H_2O
Fats	Small intestines	Intestinal secretion, pancreatic juice, bile	Fatty acids and glycerol	CO_2 and H_2O
Proteins	Stomach, Small intestines	Gastric, Pancreatic and Intestinal Secretions	Amino acids	Nitrogenous compounds, Sulphur, Phosphorus and H_2O
Inorganic Salts and Water	Unchanged during the process of digestion.			

CHAPTER II.

FOOD FACTORS : PROTEIN—THE BODY BUILDER

Milk forms the food of the young ones of all mammals. The young ones do not merely maintain themselves on milk, but they also grow on it. This means milk contains elements which promote body growth. The main elements of milk are protein, mineral salts (like calcium) and fat. It can be said therefore that these elements are conducive to body growth.

Our hmman body is both a living organism and a machine. As a living organism it is formed in the mother's body and after birth grows to its full extent by taking food. Thus the formation as well as the growth of the body depends on food. In other words, whatever constituents are found in the body are ultimately derived from food.

In a sense we can compare the human body to a field. Like the field the body is composed of innumerable plants. In terms of Physiology these plants are called cells. Just as fields are different depending on the nature of the crops grown on them, so also the body is made up of different kinds of fields containing different kinds of cells. Thus there are fields of bones, flesh etc. These body fields are termed tissues. Different tissues have a predominance of different elements. But all the same one basic element essential for the formation of any cell or tissue is Nitrogen. Without Nitrogen no cell is formed. Therefore, Nitrogen is said to be the cell-forming element.

1. Multiplication of cells.

From the very birth, the child's body contains all the necessary tissues. As the child advances in age, its body

cells derive nourishment from the food and grow. The cells grow in two ways. 1. They grow in size and 2. They multiply themselves, as the banian tree does through its offshoots. Thus the growth of the cells in size and number is the growth of the body.

Since no cells are formed in the absence of Nitrogen, it is clear, that the growing of the cells without Nitrogen is impossible. Therefore young children, whose body cells have yet to be formed stand in special need of protein. It also follows that children require more of protein than adults whose bodies have stopped growing. Once the body has attained its full growth its protein requirements are meant to replace the ordinary wear and tear or to meet special needs, consequent on disease or defficiency. Thus, protein is specially needed in young age. If in that age enough protein is not supplied, the body will not grow to its full size; a good supply of it afterwards will be of no use. Before birth and after birth till the weaning period the child has to receive its protein as well as other food requirements from the mother's body. It will receive enough protein only if the mother has enough of it to spare. Protein defficiency in the mother will naturally result in a deficient supply to the child. One reason why children are not born physically equal is the difference in the supply of protein in the mother's body. During the child's growth, the demand for protein etc. from the mother is unusually high and so her requirements in these are also equally high. In short, expectant and nursing mothers—and growing children are in special need of a large quantity of protein.

The rate of body growth in children is not even. At certain stages, their growth is rapid and at others it is slow. The periods between one to three years and twelve to sixteen years are marked by rapid growth. Between 12 and 16, boys and girls develop very rapidly showing signs of developed sexual organs. During this period it is a custom in some

places to give gingelly and jaggery to girls probably to meet the extra demands of protein. There is no reason why boys also should not be given the same. Every effort should be made to provide sufficient protein to boys and girls during this period of rapid growth.

2. Vegetable protein and animal protein.

The protein of the food is made up of very simple elements. Through digestion the protein consumed is broken up into simpler compounds. These compounds are called amino acids. It is only the amino acids that are absorbed into the blood.

Although amino acids are absorbed into the blood, they are *assimilated into the body cells only after a certain conversion in their composition.* Not all amino acids are capable of such conversion. Some are converted easily, some with difficulty and others not converted at all. These are therefore called suitable, less suitable or unsuitable amino acids. Suitable amino acids are assimilated into the body cells, and unsuitable ones have to be thrown out of the body as a waste product. The Nitrogen compounds of any excess of suitable amino acids have also to be thrown out. This causes extra strain on the kidneys. The other part of amino acids, namely glucose, is utilised as fuel in the body.

The body can itself synthesise from food material certain of the simple amino acids. Of the twenty known amino acids, however, there are four—Histidine, Lysine, Tryptophane and Cystine—which are indispensable for growth and life but which the body is incapable of synthesising. They have therefore to be obtained directly from food. As no body cells are formed in the absence of these four amino acids, they are called essential amino acids.

After analysing innumerable items of food, dietitians have observed that as compared to animal protein, vegetable

protein contains less of suitable amino acids and its essential amino acids are practically negligible. This means that however much vegetable protein one may eat one cannot maintain one's growth unless one takes a certain amount of animal protein. It is not enough therefore to get the full quantity of protein. It is equally essential to get the right kind of it. This is more true in the case of growing children and nursing mothers. One reason why milk is considered so essential for children and nursing mothers is that milk contains the cell forming essential amino acids in abundance.

The eminent dietician Sir Robert McCarrison, compares the essential amino acids to the vowels of the alphabet and the rest of the amino acids to the consonants. Words are formed only when vowels are mixed with consonants. In the same way body cells are formed only when essential amino acids are combined with the other amino acids of the food. It does not mean that only essential amino acids are useful and others are not useful. Neither does it mean that essential amino acids should be taken in a greater quantity than the others. The analogy of the vowels and consonants exactly fits in here. In the alphabet vowels are few and consonants many. But as the vowels are indispensable for word formation so are the essential amino acids for cell formation, though required in lesser quantities. It should of course be noted that growing children and nursing mothers require more of these essential amino acids than other persons.

In the opinion of dieticians essential amino acids should be at least a fifth of the total protein supplied to the body.

3. How much protein do we require per day ?

We have just seen that protein plays a very important part in cell formation. The protein requirements of children, therefore, whose body cells are being formed and of mothers

who provide cell forming material for the babies are necessarily greater than of others who have stopped growing and who require protein material only for replacement of worn out cells. The following table gives the daily protein requirements of various individuals.

Age		Protein requirements
Man	18—60	5.7 Tolas
Woman	18—60 *	5.0 „
Boy	10—17	7.0 „
Girl	10—17	6.1 „
Child	6— 9	5.2 „
Child	2— 6	3.5 to 4.5

In spite of the importance of protein in cell formation or replacement, it should be noted that excess of protein is harmful. There is a limit to the growth of cells in the body. Protein in excess of that limit or proteins of unsuitable amino acids serve either as carbohydrate foods or have to be thrown out of the body. Protein is ordinarily expensive and cannot replace carbohydrates in the food. Moreover the proportion of protein in any food material is always small so that only a great bulk of food can supply the required protein. The excess of Nitrogenous compounds produce a certain amount of extra heat in the body which is harmful in effect and calls for some extra strain on the organs to discard it. From this point of view in a hot country like ours it is beneficial to keep to the minimum standard of protein requirements. As vegetarian diet contains less protein than non-vegetarian diet vegetarian diet is more suitable for our climate, provided it is supplemented with milk and milk products.

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* Foot note :—According to Health Bulletin No. 23. expectant and nursing mothers require one and a half times the requirement of a woman, that is 7½ tolas per day.

4 How to get the daily requirements of Protein ?

Appendix I gives the distribution of protein in different food articles. It shows milk and milk products, flesh, fish, eggs to be good sources of animal protein. Vegetable protein can be divided into three classes—(1) cereals; like Wheat, Bajri, Jawar, Barley, Rice etc. are ordinary sources of protein, wheat containing the maximum and rice the minimum. (2) Pulses and oil-seeds are better sources of protein than cereals. (3) Vegetables though poor in protein can supply not an insignificant quota if taken in large quantities.

The tables can guide us in the selection of articles to make up our protein requirements. While making use of these tables the following suggestions should be kept in mind.

(1) Animal protein should be at least one fifth of the total requirements.

(2) Vegetable protein should not be taken from any one article or one class of articles but from different articles belonging to different classes. Every class of article is characteristic in its content of suitable amino acids. Therefore, it is necessary to have a mixture of proteins from different classes.

(3) It is more important to look to the quality of the proteins than to quantity. Proteins are useful to the body to the extent to which they contain suitable amino acids. Protein of unsuitable amino acids is waste. Therefore while calculating the total daily requirements of protein, the column giving assimilable protein should be taken into account. We have given in that column figures of assimilable proteins under the heading biological value of protein for those articles for which information is available so far.

Let us now work out some examples of daily protein requirements. A man requires 5.7 tolas of protein per day.

One-fifth of this, that is, 1.14 tolas should be animal protein. Let us suppose that he wants to get it from milk. The tables in the appendix give 2-7% of assimilable protein in cow's milk and 3.6% of such protein in buffalow's milk. Therefore, to get 1.14 tolas of protein man should take roughly a pound of cow's milk or 3/4 lbs of buffalo's milk.

A mother requires 7½ tolas of protein, 1½ tolas being animal protein. To get this much about 55 tolas of cow's milk or one pound of buffalo's milk will be required.

A child's requirement of protein can be similarly worked out.

Turning now to vegetable protein, out of 5.7 tolas of total protein requirements, a man needs 4.56 tolas of vegetable protein. Supposing he eats 8 tolas of ' Arhar ' dal, he gets from it 1.32 tolas of protein. Of the remaining 3.24 tolas let us suppose, that he gets 24 tolas from vegetables. He has still to have 3 more tolas. This he can obtain from cereals—say wheat, bajri or rice alone or from a mixture of all these. If only rice is to be selected, then according to the tables, to get 3 tolas of protein about 50 tolas of unpolished rice, 55 tolas of hand pounded rice or 56 (or more) tolas of mill polished rice are required.

If one wants to take only 20 tolas of rice per day and if it is hand pounded, he will get 1.1 tolas of protein from it. The remaining 1.9 tolas he can get either from 24 tolas of wheat flour or 20 tolas of bajra flour. If the cereals required for providing the necessary protein are too much in quantity, oil cakes of 'Til' or groundnuts can be usefully utilised. Both contain 27% of assimilable protein. 5 tolas of oil cake, therefore, will provide 1.35 tolas of protein. This will considerably reduce the bulk of the cereal food required. From the point of view of the suitability

of amino acids, Sir Robert McCarrisson is of the opinion that pulse protein is better than cereal protein and oil-seeds or nut protein is better still.

We have seen above that in view of our climate, an abundant protein intake is not beneficial, but under present conditions most of our people do not get even the minimum amount of protein required.

Every country has its own diet-characteristics. Vitamin deficiency is the characteristic of Western diet; while protein deficiency is one of the characteristics of our national diet. Therefore every effort should be made to increase the protein supply of our country. With this end in view, we are making below a few suggestions: It may be better, if oil cakes in the form of various preperations find place in our daily food. This is a very good way of getting good quality protein. Another source is to use unpolished rice in place of polished rice. A major portion of our population lives on rice. Their diet is always deficient in protein. Therefore, unpolished rice is specially beneficial to them. We shall see later on that polishing of rice removes other valuable ingredients of the grain in addition to protein, and thus lowers the resisting power of the people using this over processed and devitalised food stuff. Eating white flour of wheat brings about the same results. The tables bear ample testimony to this fact. Pulses as a class being a rich source of protein should find a greater place in our diet. If they are found hard to digest they can be malted and used. During the process of malting, the carbohydrates are converted into maltose i. e. from a polysachharide into disachharide and the protein is broken into amino acids. Therefore, malting of pulses and grains should be popularised. We shall see later on how the malting of grains is also useful from the point of view of vitamitn C supply.

5. Importance of Milk for growing children.

We have seen the importance of animal protein for growing children. Eggs, fish and flesh are sources of animal protein other than milk. Those who have no moral or religious compunctions use these other sources. In India too, such people are not few. But all the same, milk has proved to be remarkably superior to all other animal food substances from the point of view of growing children. Dr. Aykroyd quotes the following experiment in which milk was used to improve the health and physique af children in a Dr. Barnardo's Home for Boys near London in 1922—25. "The children in this institution were living under excellent conditions, and their diet was quite good according to the usual standards of English charitable institutions. There was no underfeeding; good, plain, wholesome food was provided. For some reason, however, the boys were not developing as well as might have been expected, and accordingly an experiment was undertaken to discover whether a change of diet could improve matters. Six groups of 30-60 healthy children between the ages of 7-11 were formed; these groups received the same basic diet, that is the ordinary home diet which contains 56 to 71 grammes of protein ($\frac{1}{3}$ being animal protein), 29-40 grammes of fat, and 288-347 grammes of carbohydrate yielding on an average 1900 calories. Each of the six groups were given as an addition to the "basal" diet one of the following : 90 grammes of sugar (pure carbohydrates); 50 grammes of Margarine (fat); 50 grammes of butter (fat plus fat soluble vitamins): 21 Grammes of fresh water cress (rich in various vitamins): 21 Grammes of casein (equivalent to the amount of casein in a pint of milk); and a pint of milk. An admirably conceived experiment. The children on these various regimes were watched for three years and a record of their growth and health were kept. The group receiving milk showed the most rapid increases in height and weight and were relatively free from minor ailments, fairly common

among the other boys. They were high spirited and mischievous and in general showed greater energy and vitality than the other boys.".

"One important fact emerged from large scale experiments carried out in Scotland and Northern Ireland. Skimmed milk supplements the diets of the poorer classes in the United Kingdom as effectively as whole milk".

Dr. Aykroyd further observes:— "If the addition of extra milk to the European diets improves their nutritive value, one might expect that similar addition to the much less adequate diet consumed by children in Eastern countries—diets which contain no milk at all—would have an even more striking effect. It has. Elementary school children in Tokyo, given about 200 CC of milk daily for six months showed gains in height and weight which were respectively 16 and 81% larger than those of controls receiving no milk".

But the story of milk supply in India is entirely different. According to Government figures for 1937 milk supply including all milk products comes to an all India average of 15 tolas per capita. Bombay records an average supply of 8¼ tolas and Assam has only 3 tolas. This of course does not mean that every one gets this much. As a rule milk and milk products are largely consumed by the well-to-do. And millions generally go without an iota of milk. To such, skimmed milk or even butter milk can be a boon. Our tradition has praised ghee out of all proportion. It has exhorted people to eat ghee even at the risk of incurring debts. Ghee has assumed an all-important role in our dietary. Ghee is no doubt valuable as a vehicle of vitamins. But ghee is not an indispensable factor or to put it differently, if any preference has to be made between ghee on the one side and other milk products such as buttermilk containing protein on the other, then certainly the latter is any day preferable. The body

will not stop growing without ghee but it certainly will without protein. Thus, the real value of milk depends not so much upon its fat contents as upon its protein and calcium contents. Skimmed milk and buttermilk are the same as whole milk in respect of their protein and calcium contents. It is better, therefore, that our children get at least skimmed milk or butter milk if they cannot have whole milk. Every school must arrange to supply these to its children.

CHAPTER III

MINERAL SALTS

Protein is the basic element for cell formation. Mineral salts are essential not only for cell formation but also for the proper functioning of the organs and for maintaining the general health of the body.

1. As body builders

Flesh and bones are the two main constituents of the body structure. Just as flesh consists chiefly of protein, bones consist chiefly of mineral salts. Bones are mainly composed of calcium and phosphorus. Besides being necessary for bones, mineral salts are considered to be indispensable for cell formation. They remain dissolved in blood and other body fluids. Minerals form 1/25 part of the whole body.

In a sense minerals are more important to the body than proteins; for while protein helps only in the formation of cells, minerals also help in the proper functioning of the organs and in maintaining the general tone of the body health.

2. How minerals help in the functioning of the organs

1. Being dissolved in the body fluids, they enter into every cell of the body and help in the contraction and expansion movement of the muscles. It is through this movement that the heart pumps blood to the whole body. It is through this movement again that visible organs like hands and feet or invisible organs as heart, lungs, intestines, stomach and others carry out their respective functions.

2. It is because of mineral salts that cells are able to retain water. In the absence of mineral salts the cells will become dry and in consequence their contraction and expansion movement will be impaired. That is to say, the whole body will cease to function.

3. It is because of mineral salts that the worn out cells of the body and other waste are discarded. If this waste is accumulated in the body, the body machine gets out of order.

4. The digestive juices of the alimentary canal are produced by mineral salts. If there is a deficiency of mineral salts, the digestive juices will be deficient and the result will be incomplete digestion and assimilation of the food. That is to say, the body will not get proper nourishment from the food which may be rich in protein etc., but which may be lacking in mineral salts, which form part of digestive juices. The protein and other constituents in the food will not be fully utilised. Thus it is mineral salts that keep the body wet and help the proper digestion of food. Just as a man dies of starvation and thirst, similarly he will die if his food is deficient in mineral salts.

5. Like the digestive juices, there are internal harmones, maintaining balance or control over the whole body economy. These harmones are also produced from the mineral salts. Digestive juices only digest the food but these internal harmones control the feelings and the thoughts of the person. This shows the importance of mineral salts even in regard to the intelligence and the character of man.

6. It is due to calcium that blood clots when exposed to air. This is the reason why the bleeding of a wound stops after a time. If there is not enough calcium in the blood any wound is sufficient to drain out all the blood of the body.

7. The assimilated food is oxidised in the body and this releases energy in the process. It is the function of the hemoglobin in the blood to supply Oxygen to the body by drawing it from the air through the lungs and throwing out the Carbon-di-Oxide of the body again through the lungs. All this is possible only through the agency of the hemoglobin which is an organic derivative of iron in the blood. Without Oxygen being supplied through this agency, the food will not be oxidised and energy will not be released; nay, the body will die out in a few miuntes. This shows how important a part a mineral like iron plays in keeping the body alive. Iron deficiency in food will make the light of life dim.

3. How minerals maintain health

Protein, carbohydrates and fat produce acidity in the blood and other body fluids, and therefore in the cells also. If this acidity increases beyond a limit, it results in disease or even death in extreme cases. Mineral salts which produce alkalinity neutralise this acidity, and keep it under control. If the ratio between acidity and alkalinity is maintained through proper food, then the body will have an acid alkali equilibrium and therefore good health.

Minerals enter into the composition of the cells of all organs, such as the digestive, excretory, circulatory, and respiratory, and thus are intimately connected with every process in the body. Due to this their deficiency in any one part is sure to upset the whole body economy.

The vegetable kingdom is divided into two distinct classes—acid forming and alkali-forming. Roots, leaves and fruits are largely alkali-forming and nuts and seeds are acid-forming. Since our staple food consists mainly of cereals like wheat, rice, bajri, and pulses, nuts, oil-seeds etc., it is predominantly acid-forming. To neutralise this enough of alkali-forming fruits, vegetables etc. should be taken.

Even in the formation of seeds nature seems to have made a distinct division. Whatever mineral salts are to be found in them are concentrated mostly in the outer layers and the germ. In polishing rice or in producing white wheat flour, the outer layers and the germ are almost completely removed. So these products are devoid of mineral salts as well as other protective food elements like protein, vitamins etc.

It is necessary to realise the importance of the minerals contained in nuts and grains as compared with those in leaves. Seeds contain less minerals but they are of greater biological value. That is to say, they are better assimilated. In passing on food elements from leaves to the seeds, nature brings about a certain transformation which aids our assimilation. Moreover, seeds form a major portion of our food and as such can provide a great portion of our mineral requirements. Therefore, it is most important that we utilise all parts of the food grain.

If this broad classification of food materials is remembered, it will be easy to make a proper selection of foods so as to maintain the balance between acidity and alkalinity. In fever, acidity increases; therefore diet during such illness should be mostly alkaline, namely fruits, vegetables etc. together with plenty of water. Flesh and grains should be considerably reduced or altogether given up.

There are about twenty kinds of mineral salts in the body. Body health can be maintained only if food can provide all these mineral elements in their correct proportions. But from the practical point of view, it is not necessary for us to consider every mineral element in detail. If the four principal minerals calcium, phosphorus, iron and iodine are secured in sufficient quantities, others will automatically have been obtained also. It has been possible to diagnose defi-

diseases only in respect of these four minerals. Nothing has been ascertained about the evil effects of the deficiency of other minerals. It is also unnecessary for us to worry about the deficiency of phosphorus and iodine. If food that provides enough calcium is taken, it will provide enough phosphorus as these often go together. Vegetables and fruits contribute iodine. Deficiency of both these minerals is related to particular regions whose soil is poor in these elements. Ordinarily, therefore, these two need not cause us anxiety. Thus the only two important mineral elements which we should be careful to secure are calcium and iron. Most patent medicines relate to these two so far as minerals are concerned.

4. The two important minerals

1. *Calcium* :— Calcium is the most important of all the mineral elements. It bears direct relation to every part and every process of the body. Of all minerals in the body calcium exists in the greatest proportion. Bones are practically made up of calcium phosphates. That is why growing children whose bones are being formed, and mothers providing bone-forming material to the children, require plenty of calcium and phosphorus.

Calcium being so important for us, its deficiency leads to various diseases. The evil effects of this deficiency are more especially marked in the case of growing children. Dr. Aykroyd quotes the following paragraph regarding the results of calcium deficiency from the Annual report of the Chief Medical Officer of the Ministry of Health for the year 1933, England. " A deficiency of clacium during the growth period, when the effects of inadequate diets are particularly liable to become manifest, would result in defective development of the bony skeleton. This is the most obvious effect of such a deficiency but others less striking, though just as

important would occur. The proper functioning of contractile tissues depends on the presence of a certain concentration of calcium ions in their environment, and as the calcium in the blood is lowered by calcium poor diets, the contractile elements in the body, *e. g.* the musculature of the circulatory and alimentary systems, would not play their requisite parts in a proper fashion. There is also evidence for believing that absorption of carbohydrates would be reduced by deficiency of calcium in the blood. Further, the metabolism of calcium is intimately bound up with that of phosphorus and with the function of the parathyroid-gland, so that any disturbance of the former is bound to lead to disturbances in the metabolism of phosphorus and in parathyroid function. In addition, since calcium plays a dominant role in maintaining the selective permeability which is an essential characteristic of all living cells, there is probably not a function in the body which would not be adversely affected by continued ingestion of diets low in calcium. Widespread and far reaching effects may thus be liable to result from even a single dietary deficiency."

Nothing more need be added to emphasise the importance of calcium in the diet. Only, this presents a sharp contrast to our present day diets which are as a rule deficient in calcium.

2. *Iron* :— The total iron content in the body is less than 3 grammes. But its importance to the body is out of all proportion to its quantity. Most of it is concentrated in the blood. Iron deficiency in the blood changes its colour and makes a person look pale. This is what we call anaemia. Like calcium, iron enters into the composition of every cell in the body and therefore is closely related with all its processes.

We have seen before that the iron in the blood draws oxygen from the air through the lungs and gives out

carbon-di-oxide produced in the body. In this sense, iron can be said to be the agent that keeps man alive. Its deficiency therefore certainly makes the body weak.

Anaemia caused by deficiency of iron is a wide-spread disease. Even in little children it is found to the extent of about 50%, as many of them are kept only on milk till the age of about 12 months. Milk is deficient in iron. Therefore, children kept only on milk get no iron at all from the food. At the time of birth, the child has a stock of iron that will last him about six months. Dieticians, therefore, advise that children should not be kept on milk alone after six months, but should be given a little solid food also. Our tradition to give the baby his first solid food at the end of six months, thus proves to be in accordance with modern science.

Along with the wearing out of cells, blood is daily destroyed in the body and thus there is a loss of iron. This loss should be made good from the daily food.

In addition to this normal requirement of iron, diseases like malaria and hookworm destroy iron to an extraordinary extent. Malaria germs enter into the blood corpuscles, expand there and break them down. Chronic malaria, therefore, necessarily results in anaemia. In hookworm the germs in thousands find their place in the intestines and keep on eating up the blood. This also results in anaemia. In these cases of acute shortage of iron ordinary foods do not provide enough of it to make good the loss, and so concentrated doses of iron in the form of medicines will have then to be taken.

Women's requirements of iron are considerably greater than those of men, as they have to provide the extra needs of the children also. Women are therefore more liable to suffer from anaemia than men. And if by chance, women get malaria or hookworm, their condition becomes worse.

In those provinces of India where malaria and hookworm are rampant women generally suffer from anaemia. In such cases doctors give them injections of blood of healthy men. Anaemia of women giving birth to children is a great scourge in India, which must be stopped. One way is to get rid of malaria and hookworm, and the other is to increase the intake of iron through food or medicines.

5. Daily requirements of calcium and iron

As calcium and iron promote growth, children and their mothers require more of them than men. Like protein deficiency, calcium and iron deficiency can lead to stinted growth of children.

Having in view the extraordinary need of children for calcium nature appears to have provided them the best source of calcium namely milk. Except iron milk provides all the needs of the child in their exact proportions. Milk contains the best of protein, enough of calcium, the growth promoting vitamins A & D, and the energy producing sugar and fat. When it contains so many elements why is it deficient in iron alone? The reply is simple. Nature has meant milk to be the food of only babies. After that age they must be able to supplement their requirements from other sources. Till they acquire that capacity, say within six months, nature has been kind enough to provide them with a stock of iron at birth.

Milk and milk-products like buttermilk or skimmed milk are the best sources of getting calcium. Vegetables also contain enough of calcium. But it is not as fully assimilated as milk calcium. We have seen before that calcium of grains is better assimilated than vegetable calcium.

Drinking water also contains a little of calcium, though the proportion is negligible. Betal leaf also provides some calcium. Sick children are given calcium lactate powder with good results in regard to their health. Iron of vegetables like their calcium is less assimilable than the iron of grains. Therefore, it is better to depend upon seeds, nuts, gur etc. for iron.

The daily requirements of calcium and iron are indicated as follows :—

Daily requirements :—

	Calcium in gms.	Iron in ml. gms.
Man	0.68	5 to 7
Child	1.00	5 to 10
Woman	1.60	20

If the above one gramme of calcium is to be provided to a child through milk alone, then according to the tables in the appendix about 1¾ lbs. of cow's milk or 1 lb of buffalo's milk will be required per day.

We give below a few more good sources of calcium and iron.

Name	Calcium in gms.	Iron in m. gms.
Gingelly cake 5 tolas	1.37	6
Milk (Cow's) 1 lb	.55	x
Gur from Coconut palm 5 tolas	.90	1.4
Wheat flour 20 tolas	.11	16.0
Bajri flour 20 tolas	.11	20.0
Dal 8 tolas	.12	8.0

In addition to these, vegetables and fruits should also be taken in sufficient quantities. The tables in the appendix record 1.45% as calcium in til-seed. After extraction of oil from the seed the calcium remains in the cake. Oil extracted comes to about 2/5 and the cake forms 3/5 of the seeds. Therefore the calcium content of the cake will be 1.45X5/3.

Coconut gur contains more calcium than cane-gur. But sugar is devoid of all minerals.

Whole wheat flour is a good source of calcium and iron, but white flour is not. Bajri also is a good source. Unpolished rice, of course, is better but polished rice is the worst. Pulses also can be counted upon for calcium and iron.

Dates, grapes, almonds, cashewnut, walnut and dried fruits are very good sources of calcium iron and protein especially from the children's point of view. Laddus of til-seeds and gur are not only relatively cheap but also provide calcium, iron and protein in good quantities.

CHAPTER IV

VITAMINS

Protein and minerals are like bricks and mortar. Vitamins are masons and door-keepers of the body. As masons, they help in building the body out of the bricks and mortars of the food elements, and as door-keepers they protect the body from diseases of various kinds.

Although they do such important work in the body, the proportion of their requirements is quite insignificant.

1. Introductory

Now-a-days questions regarding diet have come to be thought of as relating to nothing more than vitamins. Vitamins seem thus to have thrown the other food factors into the background. Such an over-emphasis on the discussion of vitamins makes many people think that the vitamin theory is a fad. But this is altogether wrong. There is a reason behind this vitamin consciousness. Just as a new convert displays special zeal, so also the vitamins which have made their entrance on the dietetic stage only recently have caught the fancy of the public. Their discovery is so recent ; new information given about them every day is so absorbing and the results of these new discoveries are so startling that they have created an almost dramatic atmosphere around them. The discovery of disease germs was the first mile stone in the history of curative medicines and that of vitamins a second mile stone. Certain diseases like * Keratomalacia, Beriberi and Rickets, which could not

(* See appendix)

be diagnosed before have been diagnosed on the basis of the vitamin theory.

All the above diseases are now proved to be vitamin-deficiency diseases. Vitamin-deficiency causes not only such special diseases but lowers the general resistance power of the body against attacks of disease germs and reduces its vitality.

Before the discovery of vitamins, the problem of food was merely that of filling the belly. Food factors were not carefully analysed. Neither did the idea of deficiency disease strike dieticians. The discovery of vitamins is not the result of the process of analysing food factors, but has been established upon observation of diseases in groups of men and animals placed under certain circumstances. This is why some of the vitamins have not even now been chemically analysed and their nature decided as has been possible with other food factors. In the same way it has not been possible to ascertain the exact function of vitamins in the body, as it has been in the case of other factors. All that is known about vitamins is that in their absence certain diseases occur and the general resistance power of the body is lowered. That is to say, only the negative effect of vitamins has been so far ascertained.

Dieticians made many experiments before they inferred the existence of vitamins and fixed on the diseases caused by their deficiency. They compared their observations in regard to groups of men and animals placed in certain circumstances with experiments carried on certain animals. They fed these animals with definite chemical food factors such as proteins, carbo-hydrates, and minerals, and found that the results of their observations and experiments tallied.

The word vitamin indicates that these entities are essential for life. They are classified according to the diseases which their deficiency causes and are named by the letters of the alphabet.

2. Functions of Vitamins

Vitamin A (1) Growth Promoting :—This Vitamin is essential for body growth and as such growing children need more of it than adults. It will not do, of course, if adults go without this vitamin altogether.

(2) *Disease Preventing.* We know that many kinds of disease germs enter into our body and create trouble. These germs can enter through three passages. (1) through wounds, (2) through insect bite, (3) through the mucous membrane of the eyes, the alimentary canal, the respiratory passage, etc. If this membrane is clean and healthy, it will not harbour any outside germs. It is the function of vitamin A, dissolved in fat to keep this membrane healthy. Deficiency of Vitamin A makes this membrane weak and liable to be attacked by germs. In that case, disease may be caused in any of the organs, such as eyes, lungs etc. which are lined by this mucous membrane. The stone of the bladder is also due to the same reason.

Insect bites cause various kinds of fevers for which special remedies are required.

Vitamin B_1. Those organs which do the greatest service to the rest of the body require Vitamin B_1 for their proper functioning. Such organs are made up of muscles and nerves and it is the function of Vitamin B_1 to make these two strong throughout the body. In this sense, the efficient working of all the systems of the body depends on the proper supply of Vitamin B_1. Its deficiency weakens the mechanical efficiency of the organs and thus

upsets the working of the whole body. Thus if the muscles of the digestive system become weak it causes indigestion and constipation. Similarly owing to deficiency of this vitamin the muscles of the lungs and the heart become weak and impair proper circulation of blood, finally the nerves and the brain give unsatisfactory work. Thus the effect of Vitamin B_1 deficiency becomes universal in the body. From the point of view of body machinery, the one vitamin which is most important, is Vitamin B_1.

Vitamin C.—(1) The main function of Vitamin C is to purify the blood. (2) With the help of blood to assist other vitamins in building body cells, especially of bones and teeth. (3) To protect the body from disease germs that may enter the blood.

As blood exists in every part of the body, any irregularity in the blood is likely to affect all parts. If blood is deficient in Vitamin C it causes scurvy in which the gums get swollen and begin to bleed.

Note :— Vitamin C deficiency causes pain in the joints of the hands and legs. Those children which are kept only on milk and not given any fruit or vegetable juice get no Vitamin C at all. Such children keep on crying and begin to cry more if they are handled.

Vitamin D.—Though bones and teeth are formed mostly from calcium and phosphorus, the reason behind about that formation is Vitamin D. It is due to Vitamin D again that calcium and phosphorus remain dissolved in blood. Deficiency of Vitamin D, therefore is as good as deficiency of calcium and phosphorus and causes rickets. That is why patent medicines always contain both calcium and this vitamin together.

3. Distribution of Vitamins

(1) Vitamin A - Carotene :—

The action of sunlight produces carotene in the green leaves of plants. It is converted into Vitamin A in the animal body. Carotene is the only original source, from which animals can make vitamin A. Wherever green leaves containing carotene find their way into animal bodies, you get vitamin A. Thus cows eating grass, fish eating seaweeds and birds eating green food become the store houses of Vitamin A. They store this vitamin mostly in their livers. It is pasted on to milk in the case of cows and to eggs in the case of birds. Cows not eating green grass can store less of it and consequently their milk will not be rich in Vitamin A. Therefore milk in the summer contains less Vitamin A than milk in the rainy-season. This holds equally true in the case of mother's milk. The milk of those mothers who do not eat enough of green vegetables, fruits and milk will not contain enough of this vitamin. In the case of the majority of mothers in India milk is deficient in Vitamin A, hence, the emaciated condtion of their children from their very birth. As carotene is produced in the green parts of plants by the action of the sunlight root vegetables are practically devoid of it. Carrot is an exception. Fruits especially yellow ones are also a good source of carotene. Germs of seeds, contain a little carotene, which is developed when the seeds, germinate. Malted grains, therefore, contain more Vitamin A than ordinary grains.

(2) Vitamin B_1 ;—

Nature seems to have made a fine distribution of vitamins. If we understand the functions of the different parts of plants, we shall grasp the significance of the distribution of different food factors in their respective places. Green leaves are a sort of work-shop of plants. They

absorb electricity from the sunlight, carbon-di-oxide and oxygen from the air and mineral salts from the earth through the agency of the roots and the stems and create out of these simple elements altogether different products. They pass on mineral salts and juices to be temporarily stored in fruits and make the seeds and nuts become permanent storehouses of energy. As leaves are the agents making all these transformations, they retain for themselves part of all the elements they pass on to other places. That is why leaves are rich sources of salts and vitamins.

As seeds and nuts supply energy to the muscles, Vitamin B_1 which is meant to make the muscles and nerves strong is associated with this part of the plant. That is, grains, seeds and nuts are regarded as the principal sources of Vitamin B_1.

(3) Vitamin C :—

This seems to have been classed with Vitamin A, and is found in green leaves of plants and fruits. Both the fruits and the vegetables should be quite fresh and the leaves tender, if Vitamin C supply is to be ensured for it is absent in stale fruits and matured leaves. Vegetables dried and kept over lack this vitamin. Of all Vitamins, vitamin C is the most sensitive to heat. Therefore cooked vegetables are useless from the point of view of Vitamin C. Only uncooked vegetables are useful for the purpose. The mixing of coriander leaves and lime juice with 'chewda' and dals is a good method of obtaining Vitamin C. The best way is to eat salad and chutney as that is the only sure way of getting Vitamin C from vegetables.

The tables in the appendix enumerate many sources containing Vitamin C. But the real problem is how to make this vitamin available to the body.

Among fruits guavas, cashew, oranges, amla (Indian gooseberry) and lemon seem to be the best sources for Vitamin C. One amla is equivalent to two oranges in its Vitamin C content. The characteristic of amla is that its acidity protects Vitamin C from being destroyed completely even upon boiling. " Amla Murabba " is therefore useful for obtaining Vitamin C. If murabbas are prepared by steam boiling in place of water boiling the mineral salts which dissolve in water will also be retained.

The malting of grams and pulses produces a certain amount of Vitamin C. This is a good way of obtaining Vitamin C especially during summer when green vegetables are rare.

(4) Vitamin D :—

The original source of this vitamin is the sun. It is therefore called sun vitamin also. You get Vitamin D from sun's rays. Therefore it is better to expose the body to the morning sun after massaging it with a little oil. Parents who do not allow their children to go out even in mild sun deprive them of Vitamin D. Our houses should be so built as to make it possible even for women to expose their bodies for some time to the sun.

Vitamin D is more easily obtained in the tropics than in cold regions. That is the reason why Indian children suffer comparitively less from rickets than children of cold regions. Indian cow's milk contains more Vitamin D than European cow's milk for the same reason. Shade loving buffalo's milk contains less Vitamin D than that of the cow which wanders in the sun. Women observing Purdha suffer from Vitamin D deficiency diseases.

Sources of getting Vitamin D are animal products such as milk, butter, ghee, eggs, fish oil etc.

IV Characteristics of Vitamins

Vitamins A and D :— Both of them are soluble in animal fat. If cream is taken out of milk both the vitamins are removed with the cream. Ordinary heat does not affect these vitamins but prolonged boiling or boiling in the open air reduces Vitamin A of milk. The same thing happens when butter is boiled in the open air to make ghee. The way in which ghee is prepared in many parts of India destroys much of the Vitamin A. Ghee is better prepared in the early morning in a windless place and in closed vessels.

Vitamin B_1 :— It dissolves in water. Ordinary heat does not affect this vitamin. Adding of soda or other baking alkaline powders while cooking destroys the B_1 contents of food.

Vitamin C :— This is readily destroyed by heat. A high acid medium preserves it to some extent even against heat.

V. Daily requirements of Vitamins

According to dieticians the daily requirements of vitamins for an adult are as follows :—

Vitamin	A	7,000	international units
,,	B_1	·400	,, ,,
,,	C	170.0	mgs ,,

Note :— 1 international unit is one millionth of a gram and 11.4 grams make one tola.

We have shown deficiency of protein to be the national characteristic of our diet. Deficiency of Vitamin A can be said to be another characteristic, especially from the point of view of children. The existence of this vitamin

protective foods like proteins, minerals and vitamins. Deficiency diseases arise from consuming an inadequate quantity of them. If protective food factors are obtained in the required quantities, carbohydrates will take care of themselves.

Carbohydrates are of three kinds. 1. Poly-saccharide. *e. g.* flour and other starch of the grains. 2. Disaccharide as for example, Lactose (milk sugar), cane sugar, maltose (flour of malted grains) or the saliva-digested starch. 3. Mono-saccharide—such as glucose or fructose.

The conversion of poly-saccharides into disaccharides and mono-saccharides is a process of hydration. That is they become simpler sugars with the absorption of water molecules. Poly-saccharides are insoluble in water while disaccharides and mono-saccharides are highly soluble. In the process of digestion poly-saccharides are reduced to disaccharides and disaccharides ultimately to mono-saccharides. It is mono-saccharides like glucose only that are absorbed into the blood. Again when there is excess of glucose in the blood and it is to be stored in the liver, the process of de-hydration begins and glucose is converted into glycogen. This is converted into glucose when required. In this way the glucose ratio of the blood is maintained.

The glucose products sold in the bazar are directly absorbable in the blood. In cases of severe illness glucose is supplied directly to the blood by menas of injections. Honey is not only glucose but it also contains other nutritive elements and is therefore better than glucose. Honey can be compared to milk. Like milk it is the food of young ones. It contains elements good for body growth. Ripe fruits also contain mono-saocharides called fructose. While unripe plantains may contain poly-saccharides or disaccharides, fully ripe plantains contain monosaccharides. Ripe plantains

can therefore be given even to six months old infants. Indeed, there was such a practice in our country which is slowly dying out.

During the process of malting of grains the polysaccharide starch is reduced to the disaccharide maltose and thus becomes easily digestible. Malted food is considered to be good for invalids also.

Both cane sugar and gur are disaccharides. But while sugar is only a disaccharide gur contains a little protein and minerals like iron and calcium in addition to glucose. Palm gur is even better in its mineral contents than cane gur. This shows why gur either from palm or cane is preferable to sugar. From the table it will be seen that while sugar is only a disaccharide, gur has a certain amount of monosaccharide also. Starch is ultimately reduced to glucose upon digestion. Therefore gur or sugar in their pure form are not absolutely necessary. But being sweet and easily digestible, they are ordinarily preferred by people. Gur and sugar are ready sources of supplying energy. Therefore sportsmen and swimmers take sugar when they get exhausted. All the same gur and sugar cannot be substituted in place of grains as that would deprive the digestive organs of an opportunity to function and thus make them deteriorate.

Though any excess glucose in the blood is stored in the liver in the form of glycogen, there is a limit beyond which it cannot be stored. In such cases the excess has to be thrown out of the body. The harm caused in this way is not so small as not to be worthy of mention. For if this position continues for some time, the organs are overworked and fatigued and the body contracts many diseases and invites even death. This is one of the reasons of untimely death. Those whose occupation is sedantary, or whose staple diet is rice should beware of an overdose of sugar or starch. Sedantary occupation together with too much of sweets is the mother of diabetes.

2. Fats.

Fat is a second class of body fuel. Ghee, butter, eggs, fish oil are examples of animal fat; and oils in oil-seeds, nuts and other food grains are vegetable fats. From the fuel point of view both animal and vegetable fats are of the same value; but in other respects animal fats are more important than vegetable fats. Animal fats contain vitamins while vegetable fats are practically devoid of them. Animal fats are more easily digested and assimilated than vegetable fats. Further investigation may suggest other advantages of animal fats over vegetable fats. But animal fats having been prepared in the body of animals can be said to be more suitable to our bodies. It is better, therefore, to include animal fats in our daily intake of fats.

Though animal fats are thus superior in many respects to vegetable fats, the difference in present day prices of vegetable oils and ghee bears no relation to the difference in their respective food values. People who are hard working find no difficulty in digesting vegetable oils. Vitamins A and D found in ghee can be obtained, the one from the vegetables and the other from the sun. Thus vegetable oil supplemented by the vegetables and the sun can partially replace ghee. Considering the poverty of our people and the difference in the prices of oils and ghee such measures will have to be adopted. That will not oust ghee for ever. But it can certainly bring about a greater balance between the prices of oils and ghee. People have a fancy for the name and form of ghee. The Punjabis and the Marwaries look down upon vegetable oils and cook all their food in ghee. This sentiment for ghee is well exploited by the manufacturers of vegetable ghee. Who does not know that hydrogenated oils of groundnut, coconut, or cotton-seed are sold in enormous quantities in the name of ghee and that even for, fancy prices? In what respect are these hardened

oils better than the freshly expressed ghani oils ? It is true that if ghani pressed oil is to be used in the diet it must be quite fresh. Vegetable oils become rancid sooner than ghee. It is therefore essential to make arrangements by which fresh oil can be supplied to consumers. This is very simply done if individual consumers of oil stock their own seeds and get them pressed on hire as and when required in the same way as people stock food grains and get the flour ground. If this system is adopted there will be no necessity for vegetable ghee which is now manufactured in big factories.

The poor fill their bellies mostly with carbohydrates which being bulky cause extra strain on the organs of the digestive system and ultimately weaken them. All sorts of ailments are produced in the alimentary canal. The substitution of some fat in the place of carbohydrates considerably reduces the bulk of the food and makes the digestion of carbohydrates easy. Fat is therefore important for the poor, and as the fat within their means is nothing but oil, pure fresh oil becomes a very essential food factor for the majority of our population.

Further, as we have seen earlier, as compared with carbohydrates, fats contain very much less oxygen than carbon. Fats, therefore, require more of outside oxygen to keep them burning and thus produce more heat and energy in the body than carbohydrates. This is how fats help in reducing the bulk of the food intake. It is also our experience that a fat rich food keeps hunger at bay for a longer period than food free from fat. Fats have thus a greater satiety value than carbohydrates. Fats have many uses in the body besides those of supplying fuel and energy. Fat can be stored in the body to a considerable extent. This store house can be drawn upon in times of scarcity and emergency. While there is a limit to the storage of glucose in the body, there is ample scope for fat being accumulated

As fat is distributed throughout the body and is spread specially below the skin, it acts as a blanket and preserves the body heat. In places where there is liable to be pressure or friction, fat functions as a pad. It fills up the body contours and makes it look beautiful. It is fat that makes the face and the skin look bright.

Calcium is assimilated into the body if there is enough fat in the food. In all the organs of the body where friction is created due to movements, there is a lining of the mucous membrane which is richly coated with fat. It is fat that keeps the mucous membrane healthy and wards off disease germs. Fat especially animal fat is able to do this not only because of its vitamin contents but also independently.

It is interesting to note that the extra glucose in the body is converted into fat and stored. This means that fat will be accumulated in the body even if food contains none of it. That is why obesity is not reduced even when the fat supply is cut off. This does not mean that direct supply of fat in the food is not essential. We have seen reasons for this earlier. Fat supply is specially necessary in childhood.

Dieticians suggest five tolas as the daily requirements of fat for adults.

CHAPTER VI

SUMMARY OF FOOD FACTORS

Nutrition chart 1.

No.	Food substances	Special function	Chief consequences of deficiency in the diet	Distribution in nature		Remarks.
				Vegetable kingdom	Animal kingdom	
1	Proteins (made up of amino-acids which are compounds of carbon, hydrogen, oxygen, nitrogen and sulphur.)	Basic element to build body cells, replaces the worn out cells. Also supplies energy. Calcium taken along with protein is well assimilated in the body.	No cells are formed without protein stunted growth.	Cereals, pulses oilseeds and nuts	Milk and milk-products, like butter milk etc. Eggs, fish, meat etc.	Growing children and expectant and nursing mothers require more protein-especially animal protein. Animal protein should form part of every body's diet.
2	Carbohydrates contain calories, hydrogen and oxygen.	The main and the cheapest source of energy supply to keep the body. Helps in the oxidation of fats.	There are no deficiency diseases except in starvation.	Food grains, pulses, sugar, sugar cane, vegetables, fruits and		Honey and fully ripe fruits contain monosaccharides which is directly assimilated into the blood. Malted grains, cane sugar or

No.	Food substances	Special function	Chief consequences of deficiency in the diet	Distribution in nature		Remarks.
				Vegetable kingdom	Animal kingdom	
			tion and obesity are caused.			gur, milk sugar are disaccharide. All food grains and other starch are poly-saccharides. Honey and gur contain some protein and minerals in addition to sugar.
3	Fats (composed of carbon, hydrogen and oxygen.)	1. Supply energy like carbohydrates. 2. Becomes store house of energy in the body. 3. Preserves body heat.	In the absense of animal fat vitamins A and D are not obtained by the body.	Oilseeds, and nuts. All food grains (to some extent)	Milk and milk-products. Eggs, fish and meat.	Animal fats are more easily digested and assimilated than vegetable fats. Animal fat containing vitamins A and D should form part of every body's

	4. Fills body contours and protects tender organs like the heart, and the kidneys. 5. Helps in the assimilation of calcium. 6. Protects body against disease germs 7. Reduces the bulk of the food.	2. Too much of fat causes obesity.			diet. But children and their mothers need them specially.

Nutrition chart 2. **Mineral constituents in food.**

	Special function	Deficiency Diseases	Distribution in nature		Remarks.
			Vegetable kingdom	Animal kingdom	
1. Calcium and Phosphorus.	1. Essential constituent of every living body cell. 2. Most important constituent of bones and teeth — as calcium phosphate. 3. Help in the expansion and contraction movement of the tissues and thus make it possible for organs such	Rickets and osteomalacia, retarded contraction and expansion movements of the organs without calcium carbohydrates and phosphorus not assimilated in the body.	Oliseeds and nuts, whole cereal products, rice polishings, wheat bran, pulses, green leafy vegetables, fruits other vegetables.	Milk and milk-products, eggs, fish and meat.	Children and their mothers require more calcium and phosphorus. Rice eaters commonly suffer from calcium phosphorus deficiency. Calcium of food grains better assimilated than those of vegetables, and millk calcium better still. Calcium

	as the heart, the lungs etc. of the body system to do their work properly.			is very useful in diseases like consumption, Asthma and skin diseases.
	4. Calcium helps the blood to clot upon being exposed to air and thus prevents excessive loss of blood through wounds. Helps in digestion and assimilation of iron and fat in the diet.			
	5. Phosphorus essential for multiplication of cells.			
7. Iron	Are essential constituents of every living cell, and carry oxygen to the cells. Men require more iron (Haemoglobin)	Anaemic women and children	Cereals, pulses, oil-seeds, vegetables, fruits, etc.	Egg, red meat, liver	Iron of foodgrains, oil-seeds and nuts is assimilated better than iron in vegetables.

	Special function	Deficiency Diseases	Distribution in nature		Remarks.
			Vegetable kingdom	Animal kingdom	
		derable loss of blood during malaria and hook worm diseases requiring concentrated intake of iron Children kept only on milk after six months get anaemia.			
3. Iodine	1. Essential for the functioning of the thyroid gland. 2. Helps in maintaining body health. 3. Helps in better utilisation of calcium and fat elements of the food.	Defective functioning of the thyroid gland. Goitre.	All vegetable products ordinarily contain enough iodine.	Fish.	Iodine deficiency in food is a regional characteristic. The soil in the Himalayan tract being deficient in iodine produces food lacking in iodine with the result that diseases like goitre are common in that area.

VITAMINS.

Vitamin	Special action	Ill effects of the deficiency of the Vitamn	Properties	Distribution in nature		Remarks.
				Vegetable Kingdom	Animal Kingdom	
Vitamin A	1. Anti infective Defence against diseases as :— A. Intestines B. Eyes C. Respiratory passage D. Genito-Urinary passage. 2. Protects central nervous system.	1. Skin diseases 2. A factor in the causation of anaemia. 3. Xerophthalmia (drying of the eye.) 4. Night blindness 5. Susceptibility to infection.	Fat soluble 2. Destroyed by aeration at all temparatures but not by closed heating upto 120° C for ½ an hour. 3. Destroyed by exposure to light.	**Carotene.** Leafy vegetables, yellow carrot, tomato, banana, Yellow fruits like mango, papaya, orange, malted grains, yellow maize.	**Vitamin A.** Liver of sheep, milk, butter, ghee, fish meal, fish oil.	Relation of carotene to Vitamin A :— Carotene is found in plants. (orange red colour) The same is stored in animals as vitamin A. (Colourless) Green spinach, and green cabbage are weight for weight as good as best butter in their richness of carotene.

Vitamin	Special action	Ill effects of the deficiency of the Vitamin	Properties	Distribution in nature		Remarks.
				Vegetable Kingdom	Animal Kingdom	
Vitamin B_1	Necessary for growth and maintenance, anti-neuritic, makes the muscles of the different organs of the body and the nerves strong.	1. Poly-neuritis Inflammation of many nerves at a time 2. Beri-beri 3. Loss of appetite 4. A factor in the causation of anaemia. 5. General tissue atrophy. Less secretion of milk.	1. Water soluble. 2. Stable at 100° C for $\frac{1}{2}$ an hour. (Baking of bread and biscuits does not destroy it. 3. Is not found in preserved and canned foods. 4. Alkalis-baking powder destroys it readily. 5. Desiccation or exposure to air does not destroy it.	Whole grains and cereals pulses oilseeds and nuts, yeast and vegetables.	Yolk of eggs, meat	Relative potency taking that of wheat germ as 100. Rice germ 200 Lentils 80 Yeast 60 Peas 40

Vitamin B_2 Anti—Dermatitic	Pellagra (deficiency diseases of the skin).	1. Water soluble 2. More soluble to heat than vitamin B_1 Other properties same as B_1	Vegetable kingdom practically the same as B_1	Liver, Fresh cow's milk, White of eggs.
Vitamin C Anti—scorbutic.	1. Scurvy (spongy and bleeding gums) 2. General atorphy of tissues. 3. Osteoporosis.	1. Water soluble 2. Produced during germination of seeds. 3. Is found in living plant tissues where active metabolic processes are still proceeding. (green leaves and berries)	All the green salad foods, lemon juice, orange juice, tomato, papaya amla, cashew fruit.	Raw milk, meat.

Vitamin	Special action	Ill effects of the deficiency of the Vitamin	Properties	Distribution in nature		Remarks.
				Vegetable Kingdom	Animal Kingdom	
Vitamin D.	Calcifying vitamin 1. Helps to assimilate calcium and phosphorus and thus to strengthen bones and teeth. 2. Prevents diseases due to deficiency of calcium.	Rickets Osteomalacia (rickets of grown-ups.) Defective teething, Infantile titany (fits) Tendency to Haemorrage (bleeding)	1. Fat soluble 2. It gives best results when a tolerably good supply of minerals is available in foods and less starchy foods are given. 3. It is required more during period of strain, such as growth, pregnancy and lactation. 4. Crystalline Vitamin D (Calciferol) is very stable.	Leafy-vegetables Tomatoes Yellow carrot Germ of wheat and maize.	Cod liver oil butter, eggs **Special Source** Sun shine	

Vitamin E.	Necessary for the synthesis of the anterior pituitory hormone.	One cause of sterility in male and female. Tendency to miscarriage.	Fat soluble. Very stable under ordinary conditions	Wheat germ, oil, green leaves and the embryos of seeds, carrots cauliflower, Lettuce, cucumber, green pepper, raw potatoes, spinach, green peas, turnips, bananas etc.		

CHAPTER VII

MILK AND MILK-PRODUCTS

The best article of food for maintaining growth and health of the body is milk. Because of this, our forefathers had adopted cow-worship. Cow-keeping was given the same status as agriculture in our economic and social system. But today we are content to be merely cow-worshippers. We are no more cow-keepers. Of course a new consciousness has been recently aroused in this direction and let us hope that proper cow-keeping will be developed again in due course.

Our daily requirement of milk is calculated to be one pound per head per day. But the actual present day supply barely comes to about 6 ounces on an average. It is clear, therefore, that the present supply of milk will have to be trebled to meet our minimum requirements of milk. It should, of course, be remembered that mere increase in the quantity of milk is not enough. Its quality should also be improved.

The quality of milk is not the same in all cases and at all times. The milk that comes to the market is adulterated with water. But even apart from this there is a wide range in the contents of pure milk as will be borne out by the following table :—

Constituents of Cows' Milk

Substance	Minimum Content %	Maximum Content %
Water	83	91
Solid matter	9	17
Fat	2	5
Proteins	2.2	5.5
Sugar	3	4.5
Minerals	0.6	1.0

There are two reasons for this wide range in the contents of milk. Viz; 1. The breed of the cow. 2. The feed. The source of milk contents is ultimately the food of the cow. If food is deficient in certain elements, how can the milk be rich in them? Certain of the grasses are very poor in some food factors with the result that the cows grazing such grasses yield milk poor in these factors. The quality of the grasses again depends on the nature of the soil. Thus the question of health finally boils down to the question of the fertility of the soil, as we have seen in Chapter I.

To improve the quality of milk, both the breed and the feed of the cow will have to be improved. Best quality bulls should be maintained for breeding purposes and the cows should be properly fed and looked after. When this is done the quality of milk will be improved and the quantity will also increase.

What we have said above about the cow applies equally to buffaloes, goats and other milch animals.

is not the place to enter into the controversial question of the cow vs. the buffalo. We are here concerned only with the question of improving the quality and yield of milk. The tables in Appendix I give the analytical contents of different kinds of milk, and can serve as a guide for proper selection.

Special qualities of milk substances

1. Protein:—

Milk proteins are of high biological value and supply nearly all the amino-acids which are needed for protective nutrition.

2. Milk Sugar:—

Milk sugar is easily digested and so is recommended when a high calorie carbo-hydrate diet is wanted. It is lactose which under the influence of certain micro organisms, produces lactic acid causing milk to sour. Sour milk or curds especially butter milk is easier to digest than milk. Even children who suffer from indigestion can be given butter milk. The use of butter milk is said to be conducive to longevity.

3. Fat:—

Cream, butter or ghee are milk fats. The fat of milk floats on the liquid in extremely fine globules. This highly emulsified fat is very easily digested and is associated with the fat soluble Vitamins A and D.

4. Minerals:—

The inorganic substances in milk add much to its unique value as a protective food. No other food compares with it as a source of calcium and where milk consumption

is high, there is no risk of calcium and phosphorus deficiency in the diet. Milk is poor in iron.

Milk is regarded as a perfect food being rich in all the food factors except Vitamin B_1 and iron. But it is of value specially because of its protein and calcium contents. It is ordinarily valued for its fat content. We have seen above how this position requires a change of value that will give us a correct idea about the utility of the various milk-products and milk preparations from the dietetic point of view.

As milk is rich in so many valuable food substances, care must be taken to see that in making various preparations from it the valuable substances are not adversely affected.

In the light of the knowledge that we have gained during the discussion of the general principles of diet, we shall now consider the various food preparations that we make out of milk and see what food factors are affected in their preparations. What changes for instance take place when milk is converted into curds or into 'khoa' (milk-pulp)? What are the contents of butter milk and those of whey? If such matters are understood then one will know what substances one is getting out of certain preparations and what one is losing or what preparations one should make in order to get certain substances. When once the habit of evaluating food factors is acquired then even women and children will take lively interest in dietetics and grasp the relative importance of various food preparations. Only then they will understand whether they are eating for health or disease.

Let us now take a few varieties of milk-preparations and see what happens in each case. There is the whole milk

into 3 main classes. 1. Preparations made by boiling. 2. Preparations made from curds. 3. Preparations made by the splitting process.

The change of substances in all the preparations of milk made by boiling are similar. As the degree of boiling is raised to suit a particular preparation the changes become more marked. The main changes are the destruction of Vitamin C and the concentration of the solid substances with the evaporation of water due to boiling. Destruction of Vitamin C cannot be helped as from the hygienic point of view it is advisable to boil milk. Moreover its quantity in milk is not much. Therefore, its loss need not concern us The loss of Vitamin A however in these preparations is serious. But the main idea behind them is that of preservation. Healthy persons can digest even these concentrated foods if taken in limited quantities. These preparations are the best sources of getting both protective and energy yielding food factors in a concentrated form, and as such are very rich items of food. Such preparations are 'Kheer', 'Rabadi', 'Khova' and 'Pedah'. The following changes occur in making them.

1. Boiled milk

1. Water content reduced. 2. Loss of Vitamin C.

2. Kheer

1. Water content reduced considerably. 2. Vitamin C destroyed. 3. Vitamin A reduced.

A suggestion that may be made here is that kheer should be prepared out of skim milk rather than whole milk for—(1) Kheer made out of whole milk becomes very rich in fat and as such is hard to digest, while kheer out of skim milk is easily digested. (2) Kheer so made will also be very

cheap. It will be rich in all the milk constituents except fat and vitamins. Even skim milk contains some fat and to that extent some vitamins also. Vitamin A however is lost in this as well as other boiled preparations. So 'kheers' made out of whole milk and skim milk differ mainly in their fat content. If it is remembered that the value of milk lies in its protein and calcium content rather than its fat, skim milk 'kheer' will be an acceptable proposition.

3. 'Rabadi'

Boiling milk to an extent which removes major portion of its water, making it into a thick paste gives 'rabadi'. 'Rabadi' represents a step further in the boiling process than 'kheer'. Therefore the changes undergone are similar. They are— 1. Water content reduced to the minimum. 2. Vitamin C destroyed. 3. Vitamin A much reduced. Being a more concentrated form of milk than kheer, rabadi becomes more difficult to digest.

'Rabadi' can also be prepared out of skim milk in place of whole milk.

4. 'Khova' - 'Pedha'

Boiling milk to the last stage gives khova. It is a completely solid substance retaining very little water in it. It contains, therefore, proteins, calcium, phosporus, iron, sugar and fat in a concentrated form in a small compass. Khova is very rich and nutritive food and it keeps for a long period. Addition of sugar to khova makes pedha.

From the point of view of preservation and transport, pedha is a very useful preparation. Though difficult to digest, it is very good for growing children if taken in limited quantities. Like kheer and rabadi, pedha can also be prepared out of skim milk.

Preparation out of Curds

5. Curds

Addition of a little ferment to milk that is boiled and allowed to cool converts milk into curds. In the process the milk sugar Lactose is converted into lactic acid. Curd is more easily digested than milk. It is also more refreshing.

6. Butter milk

Butter milk is dilute curds without butter. It contains all the constituents of milk except fat and vitamins, although these are also present to some extent. Thus butter-milk contains protein, calcium, phosphorus, iron, a little of fat and some Vitamin A and D. Milk sugar is in the form of lactic acid. As much water is added in making butter milk, the solid substances of milk are in a much diluted form.

Butter milk is especially refreshing in a hot country like ours. It keeps the bowels clean and healthy and is said to conduce to long life.

7. Butter and ghee

Properly made butter contains 90% fat, 8% water and 2% being made up of minerals, vitamins etc. Ghee is prepared out of butter by boiling and removing its water content.

The best ghee is cows' ghee. It contains 2,500 units of Vitamin A as compared with 500 units contained in buffalo ghee. Cows' ghee also contains Vitamin D more than buffalo ghee. Moreover cows' milk and ghee have a special pleasent aroma which is not present in buffalo milk or ghee. At present cow's milk being available only in limited quantities. Ghee is ordinarily made out of buffalo milk.

The preservation of Vitamin A in the process of boiling butter into ghee, depends on the way in which boiling is carried on. If it is exposed to air and sun light much of Vitamin A is lost. Our old tradition, still practised in some places, of preparing ghee is the early hours of the morning has thus a scientific basis.

8. Shrikhand

Shrikhand is made by draining off water from the curds and beating up sugar into the pulp. Minerals like calcium, phosphorus, iron and the albumin protein being water soluble are also drained off with the water. Minerals being very important constituents of milk are thus lost in shrikhand. Thus this preparation is nutritively less valuable. If shrikhand is to be prepared the drained off water (whey) should always be utilised in one form or the other. The practise found in some places of covering the cloth containing curds with earth in order to make the pulp hard is wasteful.

After the water is drained off from the curds, the pulp contains fat, vitamins and protein. The pulp of the curds contains 22.6% protein, 18.6% fat, 1.75% minerals and 1% sugar.

Preparations made by the splitting process

9. Rasagola

Boiling milk is split up by the addition of lime juice. The split up milk-divides into three parts. Fat forms a thin layer at the top, a white powder settles at the bottom, and whey occupies the bulk of the middle portion. The fat contains Vitamin A and D. The whey contains all the minerals, milk sugar and the albumin protein, and the powder is the milk protein called casein. This split up milk is strained

through a cloth which retains casein and fat and allows the whey to be drained off. Whey with a little lime juice squeezed into it makes an excellent drink.

The solid substance left in the cloth contains the same food factors as the curd pulp of the shrikhand. Small balls made of this substance and cooked in light sugar solution are called Rasagola.

CHAPTER VIII

OUR FOOD PREPARATIONS

If we were able to obtain the same food factors from our diet as are enumerated in the tables in appendix I, the problem of diet reform would be simple. But in actual practice, the food contents as indicated by the tables undergo many a change and are even destroyed before they find their way into our body. Who bothers about these food contents while making various preparations and dishes? The majority of our women follow the traditional method of cooking and the dictates of the palate. No doubt it is true that even today when the science of dietetics has made some advance our traditional methods of cooking have much to commend themselves, and the palate if catered to properly plays an important role in the production of digestive juice. Therefore in being guided by these two considerations our women do not go far wrong. But tradition may lead to stultification and the tongue may be over indulged. Both these, therfore, need readjusting. If our women adopt the criterion of gain or loss of food contents while making various preparations, the sure foundation for diet reform will have been laid.

The science of dietetics is fast developing. Everyday new discoveries are being made regarding the effects of various food factors upon our body. We must be willing to take advantage of this new knowledge. Healthy fast on tradition alone will not do. For one thing, it is estimated about 115 million people have no food to eat and if they did eat most of us would have to go underfed. For another

thing, our food is glaringly deficient in protective food factors even if our energy requirements are met. This is due partly to our wasting these food factors, during the cooking and pre-cooking processes. This waste can be stopped, if we kept in mind the principle of dietetics. Only a trained mind can exercise discretion and change habits to fall in line with the science of nutrition. Our women who are not trained along these lines are slow, for instance, to give up eating of polished rice or maida, or to introduce articles like oilcake in our dietery. All this will have to be changed, if we are to secure proper food for our people.

We shall now proceed to examine how food factors are lost or affected in preparations other than those produced out of milk, with which we have just dealt. In doing so we shall bear the following two criteria in mind, 1. Whether these preparations help or hinder digestion, 2. Loss of food factors involved.

There are two processes involved in digestion: 1. Mechanical, 2 Chemical. Digestion means reducing food substances to the simplest and minutest form that can be absorbed into the body through the intestines. The mechanical process carried on by the mouth, the stomach and the intestines help in reducing food to very minute particles, while the chemical process performed by the digestive juices of the above organs of the alimentary canal reduce food to its simplest form.

The cooking and pre-cooking stages of preparing food are meant to help food to be digested, and are therefore termed pre-digestion processes.

The mechanical process of digestion.

We can compare the mechanical process of digestion to the process of preparing 'roties'. The grinding stones

reduce corn to flour. Our teeth do the same thing. The flour is then moistened and kneaded. The stomach with the help of the digestive juices and the contraction and expansion movements of its muscles moistens and kneads the food in the same way. Just as the dough is shaped into long rolls before balls are made out of them, so also the intestines spread along their length, the food substances prepared on by the stomach. The result of all these mechanical movements is, as we have said above, the breaking up of food substances into small particles.

Chemical process of digestion.

The mouth, the stomach and the intestines produce different digestive juices to act upon different food-stuffs. In the mouth poly saccharide carbo-hydrates are acted upon by saliva and converted into di-saccharide maltose. Poly-saccharide carbo-hydrates are not dissolved in water while maltose is dissolved. The digestive juices of the stomach leave the maltose alone which is again acted upon and finally reduced to the mono-saccharide glucose by the strong digestive juices of the small intestines.

The proteins begin to be acted upon by the hydrochloric acid of the stomach which begins to break up the complex protein molecules into the simple amino acids, which process, of course, is completed only in the intestines after the very strong juices of the intestines and the pancreas have acted upon it.

The fat particles of the food are not touched at all by the digestive juices either of the mouth or of the stomach. They are split up into fatty acids and glycerine by the combined action of the digestive juices of the pancreas, the liver and the intestines.

The minerals may be reduced to very fine particles by the mechanical process, but there is no chemical

brought about by the chemical process. They enter into the body and also pass out of it in one and the same form.

Successful working of the mechanical process

The mechanical process of digestion can be carried out successfully only if the organs of the alimentary canal are strong. As we have seen before, it is the function of Vitamin B_1 to keep these organs as also the rest of the body and the nerves fit. If food is deficient in Vitamin B_1 the muscles of the organs become flabby and their power to contract and expand is weakened with the result that the reduction of food substances to smaller articles in retarded. This is what is called indigestion.

Roughage is another factor which affects the movements of the digestive tract, particularly of the intestines. It is roughage that gives bulk to food and stimulates the organs to make the contraction and expansion movements. These movements are speeded up by the roughage rubbing against their walls. If there is not enough roughage in the food these movements become slow. Consequently the passage of the food along the alimentary canal as also the throwing out of the faeces from the large intestines become slow. Thus indigestion and constipation result.

How we carelessly retard mechanical process

We have discussed above the retardation of the mechanical process caused by the deficiency of Vitamin B_1 and roughage in the food. We shall see now how, even if the food is perfect in these respects, we may hinder the process by our own carelessness in eating. As we have seen the mechanical process of digestion means the reduction of food substances to their minutest particles. It is our teeth that do most of the work in this direction. They grind food

to very fine particles while the rest of the organs do mainly the kneading and spreading work. Thus teeth are the most effective instruments for the mechanical digestion of food. Incomplete grinding of food by the teeth therefore causes undue strain on the stomach and the intestines. A writer in elaborating this fact says, "A bad chewer cannot be a just man. A man who does not know how to maintain the balance of relationship between his own body organs cannot be expected to maintain the balance of interests of other people". He also says that bad chewers cannot enjoy peace and balance of mind.

Less chewing will also cause less salivation and thus retard the chemical process of digestion also.

Successful working of Chemical Process

The sucessful working of the chemical process of digestion depends on the production of enough and strong digestive juices in the organs of the alimentary canal. Digestive juices are produced by minerals and proteins in the food. So a regular supply of all the essential minerals and proteins in the food is a prerequisite. Lack of them will not only cause indigestion but make it impossible for the body to utilise fully all the other constituents of food which will pass out of the body in an undigested form.

How we retard the chemical process

Frying of food substances retards the chemical process of digestion to a greater degree than less chewing. As we have seen fat is digested only in the intestines. Frying leads to a coating of fat around carbohydrate and protein particles of food. These particles pass on to the intestines unchanged and begin to be acted upon only in the intestines where they are separated from the encircling fat layers. Thus the digestion of carbohydrates and proteins in fried foods

is long delayed and has to be carried out by the intestines. Frying may be all right once in a while, but if it is indulged in regularly or frequently it is sure to weaken the digestion permanently.

Fat taken along with " roti " or rice is not the same as fat used in frying. There is no coating over proteins and carbohydrates formed in the former case and therefore there is no hindrance caused to the digestive process.

There are many other factors such as overeating, unbalanced diet, irregular intervals between meals, want of enough sleep, anxiety, too hot or too cold drinks, narcotic drugs, drinking too little water, living in insanitary, ill ventilated dwellings, want of physical exercise, bad habits and others which are said to be responsible for indigestion. But here we shall restrict ourselves to the indigestion caused by our faulty food preparations. It is enough if this creates a change of values in our food preparations. It is not possible to deal exhaustively with all possible preparations but a few illustrations will serve our purpose. Milk, wheat, rice, dal, and gur or sugar are the main ingredients from which many delicious preparations are made. Bajri, jowar, maize and other similar cereals are ordinarily well utilised even today. No part of these grains is wasted during any of the processes. So they do not require any consideration here. Milk we have already dealt with. We need now to take up the others viz. mainly preparations from wheat, rice and dal.

Properties of food factors

At the outset it is well to recapitulate here the properties of food factors so that it will be easy for us to understand the change effected in them.

1. Minerals, Vitamins B_1 and C are water soluble. therefore anything boiled in extra water which is thrown away loses these factors.

2. The outer layers and the germ of the grains are rich in minerals, suitable protein and Vitamin B_1. Therefore preparations in which these parts of the grain are not utilised are deficient in these factors.

3. Vitamins A, D and E are fat soluble. Therefore excess of fat in food which passes out undigested takes away with it a large amount of these Vitamins. This is what happens in the cases of preparations very rich in fat.

4. Vitamins B_1 and C are destroyed by alkaline baking powders, as for instance in biscuits, bread etc.

5. Calcium metabolism is interrelated with that of fat. Excess of fat, therefore, passing out of the body undigested, also carries away with it part of the calcium in the food.

6. Vitamin C is most sensitive to heat. But it is partly preserved in an acid medium.

Wheat preparations

Wheat preparations can be divided into two classes. Those from Atta (Whole flour) and those from Maida (White flour).

1. Atta preparations.

In atta preparations all the parts of the wheat grain except the little percentage of coarse bran that is sieved out are utilised. Often this much sieving is also not done. Thus if the whole wheat grain is used, the day to day prepartions made from it, like 'chappatis', are very wholesome food. It is only when sweets are prepared that the question of the

waste of food factors arises. In the first place being tasty they are much relished and are generally overeaten and cause indigestion. The extra fat which passes out of the body undigested carries away with it the fat soluble vitamins and the calcium in the food. Just as due to the deficiency of fat in the food calcium assimilation is retarded, so also an overdose of fat by throwing out the calcium of the food causes calcium deficiency in the body. The rare use of these sweets, of course, is a matter of relief. Healthy persons can digest it on occasions, but if all the food factors of the sweet preparations are to be utilised " Mitahar " or eating of them in small quantities should be practised.

Moreover, sweet preparations are usually made by the frying process which, as we have seen, postpones their digestion till they reach the intestines. These preparations, again, being very soft, need no pulverisation, thus depriving the teeth of their natural function and also cause very little salivation. " Laddu " and " Halva " are such soft preparations which are easily swallowed down. This again postpones their digestion in the same way as a coating of fat over them does.

Thus, in short, in the sweet atta preparations (1) practically all the parts of the grain are utilised, but (2) due to excess of fat the vitamins and calcium are wasted and (3) there is indigestion caused by (a) richness of the food (b) overeating (c) less chewing and (d) by frying.

2. Maida preparations.

Maida is the fine flour prepared out of the starchy endosperm of the wheat grain leaving out the outer layers and the germ. It is thus devoid of minerals, Vitamin B_1 and suitable proteins. As it is mostly starch sweet preparations made out of it provide only carbo-hydrates and fat, that is fuel to the body.

Maida being devoid of Vitamin B_1 its constant use weakens the digestive and other organs of the body. Being also devoid of bran maida completes the weakening of the mechanical process of digestion and leads to constipation. The absence of minerals and proteins in the maida retards the production of digestive juices and thus disturbs the chemical process of digestion also. As maida preparations are softer than those made out of atta, they are not chewed much and are hence attended with all the maladies of non-chewing. In addition, they suffer from all the evils of atta preparations.

Maida preparations may be considered desirable from the point of view of taste and the art of cooking but nutritively they are very injurious to health, and are wasteful.

The outer layers of wheat grain contain manganese which is considered to be growth promoting. The use of maida is, therefore, specially harmful to growing children.

Let us compare "Puri" and "Halva" from the point of view of digestion. In preparing "Halva" the dry flour is first fried with fat and then cooked in ample water. In this cooking the flour particles swell and tear open the coating of fat over them. "Halva" is thus not a fried preparation while "Puri" is. But the action of the saliva is retarded in either case, in the Halva because it is less chewed and in the Puri because of the coating of fat.

Vermicelli (Sevalia) is the worst of all wheat preparations. It is made out of maida. It is not only fried but also cooked in excessive water and is hardly chewed.

Thus there are three things to be borne in mind in regard to wheat preparations. 1. Maida should be replaced by atta. Atta is better than the sujji available in the market

as that also contains no bran. Maida is devoid of both bran and germ which are rich sources of minerals, suitable proteins and Vitamin B_1, and therefore leads to indigestion, both chemically and mechanically. 2. Fried preparations, owing to their coating of fat, delay the chemical process of digestion. 3. Soft preparations being less chewed also retard the chemical processes of digestion.

Rice preparations

We have said enough about the loss of food factors of rice caused by polishing and washing and cooking in extra water. The present practice of preparing rice reminds one of the story of Chanakya being so enraged by a thorn, which pricked him in his foot, that he rested only after digging up the thorny plant with all its minutest roots. We do not know in what way rice has pricked us. But somehow we seem to have made up our minds to destroy all the nutritive elements of rice before it is allowed to enter into our stomach. Whether it is mill polished or hand polished, every effort is made to render it as white as possible. Not satisfied with this, we subject it to excessive washing, and finally, as though to make sure that no trace of the nutritive elements are retained, we cook it in abundant water which we then strain and throw away. Where can we find a better fulfilment of the proverb, " गतानुगतिको लोको न लोकः पारमार्थिकः " । ?

(Poha) Flattened rice, parched rice, puffed rice are some of the other rice preparations, which are considered to be wholesome and easily digestible. Puffed rice and parched rice can be eaten by babies and invalids also.

There is another preparation of rice which is in vogue in many rice eating tracts and which requires special mention here. It is parboiled rice. It is prepared by soaking paddy in water and then steaming or boiling it. This splits the woody husk and renders its subsequent removal either by

hand-pounding or milling easier. Striking changes are brought about in the nutritive value of rice as a result of parboiling so that it does not lose as much of its constituents as raw rice does when milled in a machine. Briefly described, they are as follows: During the process of boiling some of the vitamins and other nutritive substances contained in the germ and pericarp diffuse through the grain and cannot be removed by subseqent milling. Milled parboiled rice has thus a higher nutritive value than milled raw rice. But although parboiling before milling reduces the loss, there is still a definite lowering of nutritive value in milling in a machine as compared with dehusking by hand-grinding.

Dal Preparations

'Idli', 'Papad', 'Vadi', 'Sev', 'Bhajia' and 'Malts' are examples of dal preparations. Of these 'Idli', 'Papad' and 'Malts' are wholesome as well as light. They can be given even to invalids. In these preparations no food factor is lost. In malts Vitamin A & C are added. Being made of pulses they are good sources of minerals, Vitamin B_1 and protein.

Pulses by themselves are hard to digest, and preparations like 'Sev', 'Bhajia' and 'Vadi' made out of them, being fried in fat, are harder still. No doubt they are eaten only occasionally but those who eat them often suffer from indigestion.

It is sometimes asked whether the outer coating of pulses should be utilised or not. It contains protein, minerals and Vitamin B_1 and as such should not be wasted. But in some cases it forms too tough a coating for cooking purposes. Then it is better to use them in the malted condition when the coating will be softer. Of course pulses which contain soft coating do not present this difficulty.

CHAPTER IX

OUR STAPLE FOOD AND HOW TO BALANCE IT

We may now consider the characteristics of our staple foods and the ways and means of supplementing them so as to make them into balanced diets. Our staple food consists of a cereal which grows predominantly in the area in which we live. It can be supplemented by pulses, vegetables, fruits and milk or eggs to be made into balanced diet. Let us see how.

Cereals :

The tables in appendix 1 show that all the cereals are mostly made up of carbohydrates. They are, therefore, good sources for providing fuel to the body. But other food factors that are needed by the body are either absent or lacking in enough quantities. Therefore, those who subsist practically entirely on cereals suffer from various diseases.

The characteristics of cereals as a class are as follows : 1. They contain less protein and that too of less suitable amino acids. 2. They are deficient in minerals such as calcium, iron, phosphorus, sodium, chlorine etc. 3. They are deficient in Vitamins A, C, and D. Vitamin B_1 is also removed when rice is polished or when wheat is converted into maida. 4. They are rich in Vitamin E.

Wheat and rice contain less fat than Jowar and Bajri. That is possibly the reason why Jowar and Bajri can be digested without much additional fat, while wheat or rice so taken causes indigestion.

Variety in diet essential :

All food grains differ in their contents of amino acids. Some may be deficient in certain amino acids while others may contain these and lack in other amino acids. Taking, therefore, one and the same food grains for ever is likely to cut down permanently the supply of certain amino acids. Variety in diet supplies practically all the amino acids except the very few which do not exist at all in the vegetable kingdom. Thus those who are used to a variety in diet can do with less animal proteins than those who depend only on one kind of food grains.

Pulses :

The value of pulses lies in their richness in protein content. It is twice that of wheat and four times that of rice. Addition of dal to any cereal staple food, therefore, makes a great difference from the point of view of protein supply. One ounce of dal is equal to an ounce of meat, 1½ ounces of eggs, or 7 ounces of milk in regard to its protein content. It is true that pulses do not contain all the essential amino acids and as such they cannot replace animal protein, but pulse protein is superior to cereal protein.

Pulses are poor in calcium, sodium and chlorine, but rich in iron and phosphorus. They are also rich in Vitamin B_1 and therefore very valuable for those suffering from Vitamin B_1 deficiency diseases. They are deficient in Vitamins A and C, but malted pulses contain some of these. Vitamin C content of malted pulses is given in the following table :

Vitamin C content (Ml. Gms. per 100 Gms)

Kind of pulse	Dry.	Sprouted.
Green mung	3. 0	23. 0—25. 0
Black mung	2. 7	10. 5—18. 7
Brown mung	2. 3	11. 7
Masur	3. 0	10. 0
Peas	2. 7	9. 1
Beans	1. 25	14. 2
White gram	3. 0	7. 3
Brown gram	2. 5	7. 8

(From " Health and Nutrition in India " by N. Gangulee)

Oilseeds :

All oilseeds are very rich in proteins. They are, of course, rich in fat. Oilseeds protein is superior to that of pulses and cereals. It resembles the protein of meat or fish. In one respect it is even superior to protein of meat in that meat contains the body waste and other toxins. Oilseeds protein, therefore, is only second to that of milk. Its use, therefore, should be widely popularised. That is why we have suggested that oilcake should find a place in our daily dietary. It is a very good source of mineral elements like calcium, phosphorus, iron etc and Vitamin B_1. The cakes of almonds, groundnut and til are fit for human consumption, others being too full of rough fibres.

Fruits and vegetables :

These are classed under protective foods being rich in Vitamins and minerals. They also aid digestion because of their roughage. Both, fruits and vegetables, keep the body healthy by maintaining the acid—alkali—ratio with the help of their minerals. Both should, therefore, be considered to be an essential part of our daily diet. The idea that fruits are meant only for invalids betrays our ignorance of dietetics and is indicative of our poverty.

Having observed the characteristics of different classes of foods we may now proceed to form balanced diets on the basis of any cereal as staple food.

Wheet

Supposing our staple food is wheat in the form of atta. The atta provides enough carbo-hydrates but not enough fat. The best way to add fat is to take butter or ghee with the wheat, because they not only provide fat which is required as fuel food, but Vitamins A and D as well. Vegetable oils will provide the fat but not these Vitamins.

The atta contains less proteins of less biological value. This can be made good by the intake of milk or milk products, fish or eggs and pulses and oilcake.

A third defect of atta is its deficiency in Vitamin A. That is provided as above by milk or milk products or eggs etc. Green leaves and yellow fruits like papaiya, ripe mangoes can also provide Vitamin A.

A fourth defect of atta is its deficiency in Vitamin C. For this the best sources are fruits like guava, amla, lemon, oranges and green vegetables and sprouted grains. Thus the addition of milk, fruits, vegetables, pulses and nuts removes the deficiencies of atta in fat, suitable protein and Vitamins A and C.

A fifth deficiency of atta is its lack of Vitamin D. This can also be made good by milk and milk products, eggs or fish oil. Our body massaged with oil and exposed to the sun also produces Vitamin D.

A sixth defect of atta is its deficiency in certain mineral elements, particularly calcium, sodium and chlorine. The best foods for this purpose are green leafy vegetables, fruits and milk. Vegetables and fruits also provide roughage which aids the action of the bowels. They play their part, as noticed before, in maintaining the acid—alkali—ratio in the body.

Thus milk and milk products, dal and oilcake or nuts, green vegetables and fruits added to the atta make a perfectly balanced diet.

Rice

Now take rice as an article of staple diet. It supplies enough of carbohydrates, that is, fuel to the body. But rice contains less protein and Vitamin B_1 than wheat. Making allowance for this difference, rice deficiencies can be made good in the same way as in the case of wheat.

Bajri

1. It contains less protein and less of suitable amino acids.

2. It has more fat than wheat or rice but not sufficient to eliminate the need of extra fat.

3. It lacks vitamins A, C and D.

4. It lacks in minerals specially calcium, which it contains less than wheat or even polished rice.

As all the parts of the grain are utilised, Bajri provides enough Vitamin B^1.

Thus it is on the extent to which the deficiencies of various cereal grains are made good by the use of other foods such as milk, vegetables and fruits, pulses and oilseeds, containing suitable proteins, fats, mineral elements and vitamins, that the physical development and well being of our people depends. But unfortunately this has become a serious problem for us, the solution of which will require equally serious attention.

CHAPTER X

OUR FOOD PROBLEM

When on the one hand we think of the energy yielding and protective food factors that maintain the health, vigour and working efficiency of our body and mind, and on the other hand, survey the actual state of affairs in India, our food problem seems insoluble. In this poverty stricken land where is the wealth necessary for obtaining the required food factors ?

Poverty and Ignorance :

The reasons of our starvation and malnutrition are commonly attributed to poverty and ignorance. But even our illiterate village people realise the waste of valuable food material caused by polishing rice or grinding flour in mills. They regard mill polished rice and mill ground flour as definitely nutritively inferior and even injurious to health. But still if they get rice polished, or flour produced in mills the reason is attributable to the lack of bodily vigour brought about by undernourishment which is traceable to nothing else than poverty. The so called ignorance of the science of dietetics is ultimately traceable to poverty. It may be that our masses are not conversant with the present day terminology of the science of dietetics but they are certainly not ignorant in a general way of the nutritive value of differnt foods. Present day science divides food into energy yielding and protective classes. In our popular way the same thing is expressed by saying that food grains only fill the belly but no vigour can be gained or health maintained without milk or milk products etc. The conclusions are the same in either

case. Our people undoubtedly know the value of milk and fruits. If they are not eating them it is only because their pockets are empty. Ultimately then, our food problem can be solved only when our poverty is ended.

However, till that great problem is tackled, relief work can be carried on by stopping the wastage caused in the process of preparing food products. Educating the masses in the newer knowledge of nutrition will be very helpful in this relief work. Incidentally it will serve the purpose of breaking the inertia of the masses, however it may have been caused, but which must be broken if any headway is to be made. Moreover, the knowledge so gained will be of permanent benefit in eradicating malnutrition, which may have more to do with ignorance of dietetic principles than to poverty.

An astonishing feature of our food position today is the fact that millions of our people, though starved or undernourished, do not realise that they are underfed. Continued underfeeding has lowered their metabolic ratio and they are content with food very much less than the average standard. What is the result? We do not find our people leading healthy, energetic, active and joyful lives. Their life is like a tottering house which crashes to the ground at the first blast of wind. Their power of resistance having been reduced to the minimum they fall an easy prey to the attack of disease germs. Dr. N. Gangulee describes the condition of health of our people thus- " Even a casual visitor to India cannot fail to observe the poor physique, under developed muscles, stunted growth and anaemic condition of the bulk of our population. The majority of the labouring class is starved, nervous, weakly, and morose; derelicts, semi-derelicts, youths with the premature appearance of old age crowd the industrial centres and mining areas of India. If one cares to investigate further, it becomes evident

that the Indian masses have low power of endurance, that they are very susceptible to infectious diseases and that the pessimistic outlook of life may even be due to their being habitually under-nourished or mal-nourished." ("Health and Nutrition in India" Page 27)

All this may be due to our poverty. But what is our poverty due to ? Our rulers say that it is due to our too huge a population.

2. Population.

We are said to produce children like rabbits, and so our population is out of all proportion to our capacity to feed them. It is further said that raising the nutrition standard of our people by increased production of food will not solve our problem, as that will only lead to a still greater increase in our numbers. We are thus in a viscious circle from which it is difficult to escape.

Does better nourishment lead to over population ? Dr. Aykroyd quotes tho evidence of Mr. A. J. H. Russel the Director of Public Health, Madras " I think the first thing is to spread education in hygiene. I am not going to mention birth control because that would be impossible in a country like this. But if you educate people in ways of healthy living, the result will inevitably follow. In one group in the city of Madras it has followed already. I examined the birth rate figures for Madras city in 1924 and 1925, and to my amazement found that the birth rate among the brahmins of the city was practicaliy equal to the birth rate among the Europeans. The birth rate of other communities gradually rises as one goes down the social scale until you get the lowest class of all, where it is practically double the brahmin birth

(In " Human Nutrition and Diet " page 200)

rate, so that I think, if you could get eduacation in hygiene spread among the whole population the question of overpopulation would not arise."

This observation of the limitation of family with the rising of the standard of living is borne out by experience throughout the world. The argument, therefore, that the raising of the standard of living in India would increase her population and thus leave the problem of adequately feeding them unsolved, is fallacious and looks like special pleading. When the raising of the standard of living in England and other western countries has not increased their population out of proportion why should it do so in India ?

But yet the same Director of Public Health in Madras, objecting to spending large sums of money on irrigation says, "These (irrigation schemes) would undoubtedly increase food supply, but the benefit would be only temporary. Increase in numbers would rapidly absorb the extra supply of food and the final result would simply be a larger population with the same standards of life and diet as the present population. Sooner or later scarcity must come."

Do not the two statements quoted above, contradict each other ?

Never mind the Director of Public Health of Madras. A scientist like Dr. Aykroyd himself came out with the same kind of imperialistic complacency when he says : "In India Britain has kept the peace and prevented wide spread death from famine. What more, it may be asked, could the most well meaning administration do ?" We wonder whether Dr. Aykroyd would revise his opinion after the recent tragedy of Bengal famine, caused mainly by this "well-meaning" administration. The influence of persons who pass as impartial experts is more subtle and therefore more dangerous.

As much is made of the over population of India and a population problem 'created', let us examine whether the rate of growth and density of population in India is any greater than that obtaining in other countries. In this connection we can do no better than reproduce the figures compiled by Shri. J. C. Kumarappa, in his "Public Finance and our Poverty" page 73.

Censu Years	Population per sq. mile			With 1871 as base year.		
	India	France	England & Wales	India	France	England & Wales.
1871	215	174	389	100.	100	100
1881	227	182	445	105.5	104.6	114.4
1891	229	185	497	106.5	106.3	128
1901	210	188	558	97.6	108	143.4
1911	223	189	618	103.6	108.6	158.8
1921	226	184	649	105.1	105.7	166.8

Summary	India	France	England & Wales
Increase during the half century	5.1	5. 7	66.8
Average per decade	1.0 %	1.15 %	13.3%

The normal increase should be about 10 % per decade.

These figures suffice to show that our increase in population is not anything extraordinary, and if much is made of it, it is only to direct our attention from the real cause of our poverty, viz. foreign rule and exploitation.

3. Production of protective foods.

India's food probelm is two fold. She has to makeup her deficiency of the energy yielding food factors. But what is more important for her is to find ways and means of raising the production of protective foods, lack of which is the fundamental characteristic of our national diet, and which is at the root of the low vitality of our people. The problem is by no means easy. Protective foods are far more costly than energy yielding foods as is borne out by the following illustration.

Experience throughout the world has shown that an acre of land can feed a larger number of mouths if it is used for producing food grains than if used for breeding cattle, sheep or poultry for consumption. Thus an acre of land provides 6 food units through eggs, 8 from mutton, 40 from milk and 100 from grains.

American dietician Dr. O. E. Baker has worked out the following table on the amount of land required per capita to produce diets of four varieties thus:

Diet	*Acres*
1. An emergency restricted diet	1.2
2. An adequate diet at minimum cost	1.8
3. An adequate diet at moderate cost	2.3
4. A liberal diet	3.1

The first diet consists largely of cereals, the second includes milk, meat, fruits, vegetables etc., the third being richer in milk and other nutritious foods, and the fourth consisting of the least amount of cereals but the greatest amount of other food articles. The cost rises steadily from diet one to four.

As against this the land available in British India is as follows :

Particulars	Acres per head
Total area	2.44
Cultivated area, current fallows and cultivable area	1.72
Area actually sown	.72

Balanced Cultivation

It is ordinarily presumed that an acre of land provides more calories through the production of grains than through any other food. But, apart from the question of calories, the grains are very poor suppliers of protective food factors. Therefore, if we aim at getting these factors from cereals only, huge quantities of grains will be required. On the other hand, if the grains are substituted and supplemented by foods like fruits and vegetables, milk and its products, gur, nuts and oilseeds, etc, the protective food factors required to make up a balanced diet may be obtained through lesser quantities of these types of food than through grains alone. Even the supply of calories per acre is greater in the case of gur and of the root vegetables like potato than in the case of cereal grains. Thus, a balanced diet may be a double blessing and may offer the solution to our problem. It reduces the per capita requirement of land and at the same time, it supplies the body with all its requirements in their correct proportions so as to keep it fit and healthy. It is calculated that the per capita land available in India at present for food cultivation comes to about o. 7 acres. This very land which is found to be too inadequate to meet our requirements in food according to the present distribution

of cultivativation, becomes sufficient in the reordered system of agriculture. In this manner, the land of the locality should be so distributed for the purpose of growing crops as to provide its population with all the needed materials for a balanced diet, clothing and all primary necessities. This aspect of the question should be thoroughly investigated and a definite plan chalked out and enforced by licensing the farmers to grow only certain crops on their lands. The following table shows land distribution for balanced cultivation for a population of one lakh :—

Diet	Ozs per day	Calories	Lbs per annum	Land required in acres	For seed and waste 15 percent Extra	Total	Percentage land distribution
1	2	3	4	5	6	7	8
I Diet							
Cereals	16	1600	365.00	43,400	6510	49,910	65.2
Pulses	2	200	45.60	5,400	810	6,210	8.0
Gur	2	200	45.60	1,200	180	1,380	1.8
Nuts	1	145	22.80	2,600	290	2,900	8-4
Oil	½	...	11.40	3,000	450	3,450	
Ghee	½	255	11.40				
Milk	12	240	273.75				
Vegetables	8	48	182.50	1,600	240	1,840	2.4
Potatoes (tubers)	4	100	91.50	1,000	150	1,150	1.5
Fruits	4	52	91.25	900	135	1,035	1.5
II Cotton			12.50	7,500	1125	8,625	11.3
Total	...	2860	...	66,690	9,990	76,590	100.3

This table provides for a balanced vegetarian diet yielding 2,860 calories per day for the average person and allows for the growing of cotton for 25 yds of cloth per annum per head. For non-vegetarian diet 6 ozs of milk may be substituted by 4 ozs of meat or fish and one egg.

4. Planned agriculture.

The following table taken from "Your food" by Sri. M. R. Masani gives a rough estimate of the total supplies of food stuffs available in India.

Cereals	53. 5	Million tons.
Pulses	7. 5	,,
Fruits	10. 7	,,
Vegetables	9. 0	,,
Groundnut	2. 0	,,
Sugar	5. 0	,,
Milk	18. 8	,,
Meat	1. 0	,,
Fish	0.67	,,
Eggs	3,3000 million	

Working out the total available calories from the above supplies Sri. Masani shows that every one of us gets on an average 800 calories less per day than what we should have. He has further worked out these figures to show that about 115 million of our people will have to go without any food at all if the rest should eat an adequate and balanced diet.

In a 1944 publication entitled "Technological Possibilities of Agricultural Development in India" published by the Government of India Dr. Burns has tried to assess the technological possibilities of the crops in the future in the light of the yield per acre which research so far has shown to be possible through such means as improved varieties of seed, irrigation facilities, the use of manures, and protection of crops from pests and diseases. His conclusions in regard to the following crops raised in British India are summarised

in the tables below. He shows that if proper efforts are directed towards increased production of food stuffs, there is every likelihood of our food deficiencies being completely wiped out.

Crops	Total Present production per annum	Possible enhanced production	Percentage of enhancement
Rice	28,000,000	36,400,000	30
Wheat	9,000,000	12,200,000	35.5
Jowar	4,000,000	4,800,000	20
Bajri	2,200,000	2,500,000	13.5
Maize	1,964,000	2,455,000	20
Gram	2,666,000	3,200,000	16.25

Potential Production

(A) Milk

Region	Potential daily production of milk per head of human population in Ounces			
	Cow's milk	Buffalo milk	Goat's milk	Total
I	4.58	0.54	0.08	5.20
II	5.11	4.91	0.29	10.31
III	7.51	11.98	0.66	20.15
British India	5.41	4.99	0.30	10.70

Egg Production

Region	Total Poultry population Million birds	Potential egg production per annum	
		Total in Million eggs	No. of eggs per head of human population
I	37. 6	1,551.6	22.72
II	38. 1	1,468.8	10.37
III	9.73	299.3	6.58
British India	83.43	3,319.7	12.98

The figures for the supply of vegetables and fruits should be regarded as merely indicative. In the absence of reliable figures, Dr. Burns has not attempted to show the possibilities of increase in production in this regard. But if our agriculture is to be brought under planned economy, production for local consumption will have to be adopted as the criterion. In that case, production of food shall be given the first place. The area of about 7,226,000 acres, utilised at present under such commercial crops as sugarcane of the factory variety, jute, indigo, tea, coffee, tobacco, will have to be brought under food crops.

Much of this area, being irrigated and manured, is very suitable for raising fruits and vegetables. The sugar from cane can be replaced to a considerable extent by gur and sugar from palm trees which grow wild in uncultivable lands. The reduction of area under commercial crops is not a new idea either. It has been brought into force by the present Government because of the war but it will have to be firmly adhered to also in the future. After all the demand for foods should weigh far more than the demand for luxuries.

A kitchen garden movement propogated on an extensive scale can prove very useful in providing some of our needs for fruits and vegetables.

Moreover, to increase our food supply, it is necessary to increase the fertility of the soil. The Indian soil fertility at present is said to have reached its lowest limit. Soil erosion, lack of enough and proper manures, and bad cultivation have all played their part. It is important to remember that improvement in our food position requires not only a greater quantity of production but also a better quality. All this is possible only if the soil is replenished by all the available manuring stuffs in the land. Farm yard manure, compost, night soil, oilcakes, bones and other waste should be fully utilised and soil erosion stopped.

It has been suggested that artificial chemical fertilisers should be introduced in our agricultural practice. The following quotation from "Health and Nutrition in India" by Dr. N. Gangulee page 283 is of interest in this connection.

"Apart from the consideration that they are expensive and do not really rehabilitate the soil, their application tends to diminish the nutritive value of crops. Commenting upon the form of intensive agriculture which encourages the use of chemical fertilisers, Carrel observes: 'Mass production has modified the composition of wheat, eggs, milk, fruit, and butter although these articles have retained their familiar appearance. Chemical fertilisers, by increasing the abundance of crops without replacing all exhausted elements of the soil, have indirectly contributed to change the nutritive value of cereal grains and of vegetables".

Again on page 282 in the same book Dr. Gangulee quotes a Polish agricultural expert, thus: "Land receiving farm yard manure yields wheat and other cereals of greater

nutritive value and of higher vitamin potency than those grown in fields treated with chemical fertilisers. Tretiakov in Russia increased the protein of spring wheat from 13. 48 to 16.30 percent and the phosphorus of winter wheat from O. 77 to 1. 22 percent by fertilising with farm yard manure."

And in regard to the bad effect of artificial fertilisers on the soil, Sir Albert Howard, former Imperial Economic Botanist to the Government of India, speaking at the East India Association, London, on November 15, 1945, said, " The use of artificial manures will give increased yields at first, but after a few years, the yield will fall, crops will lose their nutritive value and become diseased, and so will men and women in India. We should end with desert alkali land. It would not be merely an error of judgment to introduce artificial manures. It would be a crime." (Reuter-Hindu. Nov. 17, 1945)

On the question of chemical fertilisers Paul Norton writes—" Many agricultural experts are becoming increasingly worried about the effect that our artificial fertilisers and insect destroying sprays may be having upon earth worms. Chemical fertilisers are no good to worms-they cannot make use of the food they contain and constant application of them in place of organic manures might have the effect of reducing the worm population. This is one of the reasons why they urge the use of farmyard manures and vegetable composts instead of chemical fertilisers.

Very few people realise the part the earth worm plays in our economy; it is hardly an exaggeration to say that without worms there would be no agriculture, for the worms do the work which neither the gardener with his spade nor the farmer with his plough can perform so effectively. The worm works for the gardener in various ways. One of the most important is in irrigating and draining the land.

The worm driving its way through the soil, makes tunnels, through which rain water is able to percolate and at the same time makes the work of roots in penetrating outwards and downwards easier. "

The worms also enrich the land, first by carrying the fine soil upwards and secondly by pulverising the soil and changing the decayed and other matter in it into forms by which they can easily be assimilated by plants. "

5. Grain Storage :

Not enough attention has been focussed on the extent of damage caused to food grains by want of proper storing facilities and by the loss incurred during processing the corn. The "Grow more food" campaign initiated by the Government of India is a step in the right direction. But it would seem that the Government is concentrating only on this propoganda and have not touched the method of stopping the waste caused in storing and processing of corn. Increasing the output of food grains involves long term policies and the immediate results may not be very far reaching. In spite of all persuasion, coercion and facilities, their drive to grow more food has resulted in the total annual increase in the production of food grains in India of roughly about 5.5 million tons or 9% on the normal total output of about 60 million tons. As against this, the damage of food grains caused during storage is calculated on a conservative estimate to be 3.3 million tons, or about 5½% on the total production. In preparing maida from wheat and polished rice from paddy roughly about 5% of the total production of corn is wasted, not to speak of the waste caused in the cooking process of rice. Thus the loss in storage and preparation of food grains is more than what is achieved by way of increasing the output.

These facts are enough to emphasise the supreme necessity of finding out ways and means of stopping this enormous waste. It should be remembered that along with this quantitative waste the quality of the grains also gets very much deteriorated, often producing diseases. We shall confine ourselves here to the problem of storing food grains.

Taking wheat as an example, out of about 10 million tons of annual production about 5 million tons reach the markets to be stored and distributed, the remaining 5 million tons being conserved in their place of production. So far as local storage in individual houses is concerned people are using various forms of vessels such as earthenware "Kothis" or bamboo "Dolas" and resort to various preserving agents such as castor oil, neem leaves, mercury, etc. All these methods are good for private users and the damage estimated on this form of storage is not much. The problem only arises in regard to the storage of grains in market places. Somehow or the other, the merchants holding large stocks of grains have not become alive to the dangerous loss caused during this storage, propably as they cover their own loss by realising high prices. But all the same the damage harms the society as a whole. It should be the concern of the Public Health Departments and Local Governments to stop the waste and deal with it in the same way as with food adulteration.

The grains have to be protected from dampness and weevil and vermins. These latter can creep into the crevices in the floors and walls of the buildings and thus survive from season to season. It is not possible to clean completely such places nor can they be protected from moisture. From both these points of view godowns having 'pucca' floors and walls having a few outlets which can be controlled, are essential. If the enormity of the loss incurred in storage of

present is realised it should not be difficult to persuade municipalities or even private merchants to construct such godowns. People are building houses to be rented out. There is no reason why pucca godowns for grain storage should not be built even as a matter of investment. Such godowns have been built in Muzaffarnagar in the U. P. where the higher prices fetched by the better preserved wheat grains are regarded as enough return on the investment.

The relative costs based on actuals, of storing 250 maunds of wheat at Muzaffarnagar for 8 months are shown below.

	Pits.		Kothas.	
	Concrete	Kachha	In Bulk	In Bags
	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
1. Storing charges	18- 0-0	15- 0-0	10- 7-6	15-14-6
	Concrete	Kachha	In Bulk	In Bags
	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
2. Loss in Storage	...	...	15-10-0	31- 4-0
3. Discount for deterioration in quality	...	19- 8-6	3-14-6	7-13-0
Total	18- 0-0	34- 8-6	30- 0-0	54-15-6
Less for gain in wt.	3- 2-0	12- 8-0	...	...
Total net cost	14-14-0	22- 0-6	30- 0-0	54-15-6
Pies per maund per month	1.4	2.1	2.9	5.3

A pucca godown having a capacity of about 255 tons will cost at present between 6 to 10 thousand rupees. If the 5 million tons of wheat that enters the trade on the whole in India are to be properly stored, pucca godowns costing between 11 to 15 crores of rupees are required. The annual loss on the 3 thousand tons of wheat, which is the estimated damage due to storage at the rate of Rs. 6/- a maund, comes to about Rs. 5 crores. Thus within three or four years the investment is recovered by the saving effected in the preservation of wheat. The same thing applies to rice also.

6. Processing of grains.

The enormity of the wastage of food material caused in India under this head can be best illustrated by taking the cases of wheat and rice. We have discussed before the loss in nutritive value involved in polishing rice and producing maida from wheat. Here we shall confine our attention to the quantitative loss involved in the two processes.

The wastage involved in maida production is well illustrated by a recent press note issued by the Government of Bombay which we reproduce in toto.

"Suggestions have been recently made in a section of the press that now that the war is over, Bombay should revert to white bread. These tend to overlook the circumstances in which Government, on the advice of the Food Advisory Council and its Standing Committee, had to prescribe wholemeal bread for the city and to exaggerate the effect of the cessation of hostilities on the food position of the province."

"The decision to issue only wholemeal atta, flour and bread was taken early in 1943 with a view to stretching out the limited wheat supplies available to the province. There has been no appreciable change for the better in the supply position since then. Actually supplies at present

available for distribution within the province today are not sufficient to maintain an adequate quantum of wheat ration in all areas. There is no indication that the end of the war will bring about any improvement in the supply position of wheat. The indications are indeed to the contrary."

"Reversion to white bread in Bombay city and the Bombay Suburban district alone would require an extra 7,800 tons of wheat per annum. Additional supplies to this extent are unavailable: they can be obtained at the expense of the already inadequate wheat ration in the rest of the province. The number of persons who eat bakers' bread is only a small fraction of the number who consume chappatis made of wheat. Taking Bombay city and the Bombay Suburban District the proportion of wheat consumed in the form of bakers' bread and in the from of chappatis is 1:7. There seems little justification for discriminating in favour of bread eaters at the expense of the rest of the population."

This is only for Bombay City and Bombay Suburbs. The loss for the whole of India can, therefore, be well imagined.

The sudden cutting off of supply of rice from Burma during this war came as a rude shock to our people and to the Government of India alike, and created an acute shortage of rice in the country. But after all the import of rice into India from Burma amounted only to 1½ million tons a year on an average. Compared with this the Indian production o rice is 30 million tons. Thus import of Burma rice formed only 5% of the total production of Indian rice. As compared with this, rice when it is polished whether by the mill or by hand, loses on an average about 10% of its original weight. Thus rice lost through polishing is twice the amount which used to be imported from Burma. Therefore if polishing were stopped there would be no need for India to import any rice from Burma or any other place at all.

CHAPTER XI

BALANCED DIET

How much food does man need? Age, race, climate, nature of work and habit are the factors that decide the quantity of food a man requires. Growing children require more food than adults in proportion to their body volume. Adolescents between 12 and 16 require a little more food than the adults as this is their period of rapid growth. Children between 6 and 12 need 3/4 the quantity of food that a grown up needs. Food required in old age is less. Boys require more than girls and men more than women. More food is taken in cold climates and cold seasons than in hot climate and hot season. Labowrers doing hard work require more food than middle class people following sedentary occupations.

The bulk of our food is utilised as fuel which produces energy and maintains body health. Even growing children require bulk of their food for energy production, as they are very active and expend a lot of energy. Even when we are asleep our body organs such as the heart, the kidneys etc are functioning. That requires energy. Half the energy produced in the body by food is daily spent in carrying on the basic functions of the body. This is what is called the basal metabolic rate of the food units, meaning the basic requirements of food to carry on the functional activities of the body. Balanced diet is based on the basal metabolic rate and adapted to the extra needs of a person arising from other deciding factors such as nature of work, climate etc.

Different food factors yield energy in different measures. We have seen that factors that Produce energy are carbohydrates, at, and protein. The energy produced by them is as follows :—

1	Gramme of protein	4.1	calories
1	„ carbo hydrate	4.1	„
1	„ fat	9.3	„

Calorie is a heat unit by which food requirements are estimated. It represents the amount of heat required to raise 2.2 lbs of water through 1 centigrade.

Energy expenditure per hour of an average man under various conditions of muscular activity.

Form of activity.	*Calories per hour*
At rest in a warm atmosphere-12 hours after a meal (basal metabolism)	68
Sitting at rest	100
Standing relaxed	105
Dressing and undressing	118
Typewriting rapidly	140
Shoe making	180
Walking slowly	200
Carpentry, industrial painting	240
Stone working	400
Sawing wood	480
Running	570

Figures taken from Sherman's "Chemistry of Food and Nutrition."

Keeping the above figures in mind dieticians work out the food requirements of persons as follows :—

Age	Consumption co-efficent	Calories
0—1	.2	250
1—2	.3	780
2—3	.4	1040
3—6	.5	1300
6—8	.6	1560
8--10	.7	1820
10--12	.8	2080
12--14	.9	2340
Female sex above 14	.83	2100
Male 14	1-0	2600

Appendix 1 gives the calorie units of food articles. With the help of these tables the food requirements of individuals, families or institutions can be worked out.

So far, we have considered food from the fuel point of view only. We must now see what balanced diet is. Composition of a balanced diet is indicated thus :

Food factors	*Grammes*	*Calories*
Protein	65	260
Fat	50	450
Carbo hydrates	475	1900
		2610

Calcium	1.02	
Phosphorus	1.47	
Iron	44 ml. gm.	
Vitamin A	7000 and more	international Units
„ B	400	„ „
„ C	170,000	„ „

Extra requirements of women during the later months of pregnancy and lactation may be very roughly indicated as follows :

Food factors	*Percentage increase in requirements*
Calories	25
Protein	50
Fat	10
Calcium	100
Phosphorus	50
Iron	50

In addition to these, requirements of all vitamins are also raised considerably.

The following may be said to constitute a balanced diet based on rice as the staple article of diet.

Rice	10	ounces
Bajra	5	„
Milk	8	„
Pulses	3	„
Leafy vegetables	6	„
Other vegetables	4	„
Oil ghee	2	„
Fruits	2	„

But this should be regarded as indicating the minimum requirements that can sustain the body. It can, however, provide no margin for reserve of energy which is always desirable and for which more food than indicated in the above illustration should be taken.

The following review by Sir Robert Mc Carrison of our national diet is illuminating and gives us an idea of what constitutes a balanced diet. " Nowhere in the world is the profound effect of food on physical efficiency more strikingly exemplified than in India. The tribes of Indian Frontier, and of the Himalayan regions, the peoples of the plains-Sikhs, Rajputs, Maharahsta, Bengalis. Ooriyas, Madrasis. Kanarese and many others-exhibit, in general, the greatest diversity in physique. And as each race is wedded to its own manner of living, to its own national diet, comparison between them is easy.

The level of physical efficiency of Indian races, is above all else, a matter of food. No single factor—race, climate, endemic disease, etc—has so profound an influence on their physique, and on their capacity to sustain arduous labour and prolonged muscular exertion. As we pass from the North West region to the Punjab down the Gangetic plain to the coast of Bengal there is a gradual fall in the stature, body weight, stamina and efficiency of the people. In accordance with this decline in manly characteristics it is of the utmost significance that there is an accompanying gradual fall in the nutritive value of the dietaries. So wrote Mc Cay, as a result of his investigations, a quater of a century ago. My own observations have served to confirm his conclusions, though I find other causes in addition to protein Insufficiency—to which he attached chief importance—for the decline he refers to. This decline extends also to the people of the South and West of India, being especially apparent in certain parts of the Madras Presidency. This is

not to say that in these parts there are not many people of good physique nor that in the North of India there are not many whose physique is poor. But speaking of the generality of the people, it is true that the physique of northern races of India is strikingly superior to that of the southern, eastern and western races. This difference depends almost entirely on the gradual diminishing value of the food from the north to the east, south and the west of India, with respect to the amount and quality of its proteins, the quality of the cereal grains forming the staple article of the diet, the quality and quantity of the fats, the mineral and vitamin contents and the balance of the food as a whole. In addition to these questions of quality there is the further one of quantity. In regard to the latter little need be said, for it is obvious that if a man is not getting enough to eat he cannot be physically efficient. Unfortunately, the numbers in India who do not get enough to eat may be counted by the hundred thousand.

In general the races of the northern India are wheat eaters, though they make use also of certain other whole cereal grains. The wheat is eaten whole in the form of chappatis made of atta.

It thus preserves all the nutrients with which nature has endowed it, particularly its proteins, its vitamins and its mineral salts. The second most important ingredient of their diet is milk, and the products of milk; the third is dhal (pulse); the fourth, vegetables and fruits. Some eat meat sparingly, if at all; others such as Pathans, use it in considerablee quantity. Their food thus contains—when they can get the food they want, which they do not always do—all elements and complexes needed for normal nutrition (with the possible exception of iodine in some Himalayan regions) and abundance of those things that matter from the point of view of the structural and functional efficiency of the body. In conformity with the constitution

of their dietries, they are the finest races of India, so far as physique is concerned and amongst the finest races of mankind. Familiar as I am with the chapati-fed races of northern India, I have little patience with those who would have us believe that white flour is as good an article of diet as whole wheat flour. White flour, when used as the staple article of diet, places its users on the same level as the rice eaters of the south and east of India. They are faced with the same problem; they start to build up their dietries with a staple of relatively low nutritive value. If their health and physical fitness are not to suffer, they must spend more money on supplementary articles of diet in order to make good the deficiencies of white flour than if they had begun to build on the surer foundation of whole wheat flour. So it is with rice, which is the staple article of diet of about ninety millions of India's inhabitants. The rice—a relatively poor cereal at best—is subjected to a number of processes before use by the consumer; all of which reduce some to a dangerous degree—its already sparse supply of certain essential nutrients. It is parboiled, milled or polished, often all three. It is washed. It is thus deprived of much of its proteins and mineral salts and of almost all its vitamins. Add to this that the average Bengali or Madrasi uses relatively little milk or milk products, that by religion he is often a non-meat-eater, that his consumption of protein whether of vegetable or of animal origin, is, in general, very low, that fresh vegetable and fruit enter into his dietary but sparingly and we have not far to seek for the poor physique that, in geneal, characterizes him. In short, it may be said that according as the quality of the diet diminished with respect to proteins, fats, minerals and vitamins, so do physical efficiency and health."

"It will be of interest now to consider the difference in incidence of certain diseases in Madras and the Punjab. In the first place, we find the tuberculosis is nearly twice as

common in Madras. Next we find that leprosy a malady which is allied in some ways to tuberculosis is much more common in the south than in the north of India; peptic ulcer (gastric and duodenal) is 58 times more common, rheumatism is nearly 5 times as common, cancer is 3.5 times as anemia and malnutritional diseases generally (excluding beriberi, which rarely occurs in the Punjab) are more than twice as common, rickets is 4 times as common, diabetes and mental diseases are 3 times as common, disorders of the heart 4 times, nephritis 10 times and infestation by round worms 20 times as common in Madras, while ulcers, skin diseases and various other local ailments are all more common in Madras. These differences in the incidence of disease can, I think, be accounted for in large part by the difference in the nutritive quality of the diets of the two peoples."

In formulating balanced diets Sir Robert Mc' Carrison suggests the following rules to be remembered :-

1. Always allow 10 per cent for waste.

2. Allow for differences in activity of different individuals, giving those who are more active 10 to 15% more than others.

3. Not less than 1/3 of the proteins should be derived from animal sources.

4. Make up the vegetable proteins from more than one source.

5. About ½ of the fats should be derived from animal sources (to provide enough Vitamin A).

6. Always aim at having the amount of vegetables and fruits in the diet at least 4 times as the amount of meat and dal.

7. When it is necessary to increase the energy value of the diet so as to provide for the unusual activity or work do so by increasing the amount of starches and sugars.

8. While making experiments in diet no violent changes in the habits formed should be made.

For ready reference, the measures used in the different tables in the book are equated below with Indian measures.

100 grammes		3.5 oz.
100 gms.		8.75 tolas
1 oz.		28.4 gms.
1 chhatak	—2 oz.—	56.8 gms.
1 tola		11.4 gms.
1 seer	—2 lbs.—	907.2 gms.

CHAPTER XII

WATER

Strictly speaking both oxygen and water are to be regarded as foods, for of all the supplies on which the cells of the body are dependent they are the chief.

Water has no fuel value as food, but it is of outstanding importance to the body, both from the point of view of structure and of function. It is the most abundant constituent of living cells.

Water is needed by our body for several purposes. By its agency food is dissolved and carried to the tissues, waste products are removed and excreted, nutrition and chemical changes are possible and the temperature of the body is regulated, to some extent, by means of evaporation through the lungs and the skin. The insufficient ingestion of water gives rise to headache, loss of appetite, disturbance of digestive functions and of the actions of the bowels, nervousness and impaired capacity for work—mental and physical. In infants, the loss of water consequent on diarrhoea, vomitting or excessive evaporation from the lungs may cause serious symptoms; failure of digestive processes consequent on the diminished production of the digestive juices, rapid loss of weight, dry skin, exhaustion, coma and convulsions.

Water forms 2/3 the weight of our body and is present in all tissues and blood. It is estimated that 80% of our food is water. We obtain this water not only by drinking water itself, but also from solid foods most of which contain a considerable amount of water. Thus, there is 70 to 95%

water in fresh fruits, 60 to 70% in boiled vegetables and 75% in milk. Besides these, body obtains a regular supply of water from the oxidation of energy producing foods. In this process, the hydrogen of sugar fats etc is oxidised to water.

Water is daily thrown out of our body in a number of ways, such as through skin, lungs and urine etc. Plenty of water is required to make up the drain of water from our body. But strange it is that very few people know anything about the use of water they drink. Most people think that provided water is clear and has no peculiar taste, they can drink it. In this chapter we will discuss briefly what are the impurities of water, what is the harm in drinking impure water and how to render impure water fit for drinking.

Sources of drinking water.

The common sources are 1. Rain 2. Well 3. Springs 4. River, canal, sweet water lakes and 5. Tanks.

Rain water is difficult to collect and store. It will have the dust and gases of the atmosphere dissolved in it. It is flat for taste but is harmless. Wells are of various types. In the shallow wells the likelihood of much organic matter is great. Deep well water is more hygenic due to the filtering action of the earth strata through which water descends. The tube and bore wells are also good, but every locality cannot have them due to various reasons. Most of the springs (both hot and cold) have a high content of mineral salts and cause diarrhoea and other disorders of the alimentary canal. River and sweet lake waters contain the least amount of mineral salts and the flowing nature has a tendency to purify the water. But these waters are easily contaminated by industrial effluents of factories, retting of fibrous materials and washing of cattle etc. Tank water is easily rendered unfit for drinking purposes in a number of ways. Special care should be taken

to protect the tank water from various sources of contamination. The ways in which contamination can occur to the tank are too numerous even to be mentioned.

Water borne diseases

There are several diseases which are water borne. That is many diseases cne be transmitted to man through the medium of water. We shall mention only the three commonest ones that come through drinking the water infected with those germs. They are cholera, typhoid and guinea worm. These are caused by microbes which freely develop in water and can even be transferred through the food kept fresh by sprinkling the polluted water. All these germs are completely destroyed if the water is boiled. Then the water is rendered harmless. Hence during the period of infection, only boiled water should be used for cooking and drinking purposes.

Impurities in drinking water :

Drinking water may contain. 1. in suspension, particles of animal, vegetable and mineral origin, microbes and other vegetable and imal organisms. 2. In solution, gases, mineral salts, soluble organic matter of animal and vegetable origin. We shall consider each of them in some detail.

Suspended matter :

If water is allowed to stay in a tall glass cylinder for 24 hours, and if a sediment occurs, it can be examined under the microscope to find the nature of the sediment whether it is animal or vegetable or mineral origin.

Dissolved matter :

(a) Vegetable matter. This sometimes lends a brownish tinge to water ; also it may impart even a sweet

or other agreeable taste to the water. If present in large quantity it is harmful to drink the water. Water of peculiar taste should alway be boiled before use to render it harmless from infection. (b) Animal matter in water indicates the presence of decomposing animal tissues and is always dangerous to health. (c) Several forms of bacteria usually occur in drinking water and are harmless when present in very large numbers. But there are certain specific bacteria like typhoid bacillus, cholera bacillus which render water unfit for human consumption. They can be detected only in a suitable laboratory. They are easily destroyed by boiling the water. (d) Gases. The gases which are usually present in water are oxygen, nitrogen and carbon-di-oxide. But sometimes sulphur di-oxide and hydrogen sulphide have also been detected. The last two usually occur in water around industrial areas and in spring and natural waters. Oxygen, nitrogen and carbon-di-oxide are harmless if present in their normal proportion. But sulphur dioxide and hydrogen sulphide are not desirable. All gases can be expelled by thorough boiling. It is carbon dioxide that gives a taste to the water and in its absence the water is dull and of unpleasent taste. (e) Mineral Salts. The mineral salts occuring in drinking water are usually chlorides, sulphates, carbonate, silicates, nitrates of lime, magnesia, soda, potash, iron etc. and very rarely of copper, lead or arsenic. The presence of these mineral salts renders the water "hard". Depending on the nature of the salt present we have "temporary" and "permanent" hard waters. In rain water there are no mineral salts. In highly hard water the amount of mineral matter is about 500 parts per million parts of water. In drinking water, it should not exceed 60 parts per million, the lesser the better. Presence of these minerals salts in water, leads to digestive troubles like dyspepsia, diarrhoea or constipation.

The presence of lead is generally due to the water being carried in lead pipes and the drinking of this water gives rise to 'plumbism' or lead poisoning. Arsenic and copper find their way into drinking water through industrial effluents.

Methods of purification :

Elaborate methods have been developed to purify water and these concern the purification of water on a large scale, as for example for town supply. Here we shall deal only with what can be done in houses and on a small scale.

1. Boiling :

The water for the day is filtered through closely woven fine cloth, boiled in a large vessel and set apart in clean, big, earthern vessels covered with lids. After 12-18 hours the water is filtered through the same cloth to remove any sediment. The water can be relied to be free from microbes and hence specific contagia and gases, though it must be remembered that other impurities still remain. Boiling removes " temporary " hardness.

2. Dis-infecting the wells etc.

The common agents to disinfect wells are potassium permanganate and bleaching powder. These may be added in small quantities, but have to be added frequently to keep out fresh infection of the wells. But-infection of rivers is more difficult.

3. Distillation :

Even though the process is costly, yet it gives the healthiest water. It is free from every kind of impurity but has an unpleasant taste due to the absence of dissolved carbon-dioxide in it.

4. Filtration :

In this method the idea is to strain the suspended matter and oxidize the dissolved organic matter. Small hand driven filters are in common use in Europe, but they are yet to find a place in our houses.

5. Chemical process :

In this process, the dissolved organic matter etc. is discharged by treatment with alum etc. filtered and sterilized (to be free from microbes) using chlorine or ozone. This process is not easy to carry out cheaply at homes, but is suitable for bigger supplies.

CHAPTER XIII

PURGATIVES

Since nutrition has much to do with the healthy condition of the alimentary canal, it is well to understand how to take care of this part of the body machinery. It is like a cyclist for whom it is good to know not only to ride but also to repair a cycle when it goes out of order.

A right mode of living and eating of nutritive food will ordinarily create no trouble in the working of the alimentary canal. But to err is human and occasions are bound to arise when the machinery gets clogged and some sort of repairs are required. That is to say the evacuation of the faeces from the intestine stops to be automatic or efficient and has to be carried out with outside help. This is what the purgatives are intended to do. They forcibly remove all the contents of the intestines and wash them clean, making it possible for the digestive process to work smoothly again.

The clogging of the intestine or what is commonly called constipation is of two kinds : 1. Chronic and 2. Acute.

In chronic constipation, bad mode of living such as want of proper exercise to the organs of the body, eating of unbalanced or badly cooked food, use of the narcotics or intoxicants, late sleeping at night etc. weaken the mechanical efficiency of the intestines, particularly of the large intestine, which has to throw out the faeces. Proper treatment for chronic constipation is, therefore, to correct the mode of living and to eradicate the causes which have created the

trouble. These measures alone, however, are often impracticable or useless because the disorder is of too long standing. In such cases, drugs are employed which act upon the large intestine, both because the stagnation takes place there, and because drugs which act with equal strength upon the whole intestine are suitable only in the case of acute constipation; their prolonged use injures nutrition, for the absorbtion of nutritive substances in the small intestine is imperfect when the contents pass through it rapidly.

Purgatives may be divided into two main groups according to their mode of action, namely the aperient mineral salts and vegetable purgatives. The activity of mineral salts is mainly due to their *peculiar reaction to water*, and vegetable purgatives empty the intestines by causing *increased peristalsis.*

Vegetable Purgatives :

From the point of view of division of constipation into acute and chronic, vegetable purgatives may be again divided into two groups.

1. Purgatives which excite vigourous peristalsis in the whole intestine and are therefore suitable only for acute constipation are of two kinds (a) mild purgatives like castor oil and (b) drastic purgatives like 'jalap'.

2. Examples of purgatives which excite peristalsis only in the large intestine and are therefore suitable for chronic constipation are 'Rhubarb', 'Cascara', 'Senna' and aloes.

Castor oil :

The oil itself is quite inert and only becomes aperient when it has been *to some extent saponified* in the intestine

by the bile and the fat decomposing ferment of the pancreatic juice to glycerine and free acid. The remaining unsaponified oil supports the action mechanically by making the intestinal valve of the hard faecal masses smooth. As the saponification commences as soon as the oil mixes with the pancreatic juice, the action begins in the duodenum. Castor oil is, therefore, a very suitable remedy for ordinary acute constipation, in poisoning, gross errors of diet, and other similar cases in which thorough evacuation is desirable. Castor oil occupies a prominent position among purgatives because it combines with certain action the property of being only slightly irritant.

Castor oil, however, is unsuitable for the treatment of chronic constipation, as continued use produces dyspepsia and impairs the apetite.

Jalap etc.

These are powerful purgatives and in large doses drastic; they also act rapidly. Their irritating action on the liver is very marked.

The senna group

All that is to be said in general of this group of purgatives is that as regards the activity and irritation of the intestinal canal, they occupy an intermediate position between castor oil and jalap. As owing to the gradual freeing of the active principles, their activity is greatest in the lowest section of the intestine, they are especially adapted for the treatment of chronic constipation.

Saline Purgatives

Some of the alkaline salts, though easily dissolved, are very slowly absorbed into the body from the intestine. They

not only remain in the intestine but also prevent the fluid there from being absorbed. Thus the contents of the intestine remain fluid, are not concentrated in the large intestine by absorbtion of water and are evacuated without the necessity of any strong peristalsis. The easily dissolved but slowly absorbed alkali salts, therefore, are good as aperients and are called saline purgatives. Mag. Sulph (magnesium sulphate) belongs to this group.

These salts as a group are less irritant and cause less pain than vegetable purgatives. But if the constipation is obstinate or caused by mechanical obstruction such as hard faeces they are less efficacious than vegetable purgatives.

The occasional employment of these salts does not impair digestion, but their constant use through a long period of time causes dyspepsia, reduces the apetite and sometimes results in obstinate constipation. They are, therefore, not suitable for chronic constipation.

TABLE OF FOOD VALUES

CEREALS

Name of Foodstuff	Hindi Name	Protein Content %	Biological value of Protein Content %	Fat %	Mineral Matter %	Carbohydrates	Calcium %	Phosphorus %	Iron Mgs. %	Calorific value per 100 gms.	Carotene International Vitamin A Units per 100 gms.	Vitamin B1 International Units per 100 gms	Vitamin B2	Vitamin C Mg. per 100 gms.	Calories per oz.
Wheat, whole	Gehum	11.8	7.70	1.5	1.5	71.2	0.05	0.32	5.3	346	108	180	+	...	98
Whole wheat Flour	Atta	12.1	8.1	1.7	1.8	72.2	0.04	0.32	7.3	353	...	...	...	...	100
Wheat flour refined	Maida	11.0	7.37	.9	0.4	74.1	0.02	0.09	1.0	349	...	40	...	...	99
Bajra (cambu)	Bajra	11.6	9.60	5.0	2.7	67.1	0.05	0.35	8.8	360	220	110	Poor	...	102
Juar (cholam)	Juar	10.4	8.63	1.9	1.8	74.0	0.03	0.28	6.2	355	136	115	Poor	...	101
Barley	Jau	11.5	8.16	1.3	1.5	69.3	0.03	0.23	3.7	335	...	150	Poor	...	95
Italian millet	Kangani	12.3	9.47	4.7	3.2	60.6	0.03	0.29	6.3	334	54	195	...	...	95
Kootu	Kootu	10.3	...	2.4	2.4	65.0	0.07	0.30	13.2	323	...	300	...	...	92
Maize	Makai bhutte	4.3	2.58	0.5	0.7	15.1	0.01	0.10	0.7	82	42	...	...	4	23
Maize dry	Makai	11.1	6.66	3.6	1.5	66.2	0.01	0.33	2.1	342	...	...	...	...	97
Maize flour	Makai atta	0.6	...	0.5	0.4	87	0.02	0.32	5.3	355	...	...	...	...	101
Oat-meal	Jai	13.6	8.84	7.6	1.8	62.8	0.05	0.38	3.8	374	Trace	325	...	...	106
Pani-varagu	Chaina	12.5	...	1.1	3.4	68.9	0.01	0.33	5.7	336	Trace	...	...	..	95
Varagu	Kodom or Kodra	8.3	...	1.4	2.9	65.6	0.04	0.24	5.2	308	Trace	110	...	...	87
Ragi	Mandal or Okra	7.1	6.31	1.3	2.2	76.3	0.33	0.27	5.4	345	70	140	Poor	...	98

Samai	Kutki	7.7	...	4.7	4.8	63.7	0.02	0.36	7.1	328	Trace	100	...	... 93
Sanwa-millet	Sawan	6.2	...	2.2	4.4	65.5	0.02	0.28	2.9	307	Trace	...	...	... 87
Talipot (treated)	...	1.3	...	0.1	1.9	89.4	0.09	0.04	22.2	364	...	...	...	... 103
Vermicelli	Siwain	8.7	...	0.4	0.5	78.7	0.02	0.08	0.3	358	Trace	...	...	... 102
Sago	Sabudana	0.2	...	0.2	0.3	87.1	0.02	0.01	1.3	351	...	...	...	... 100
Rice, raw, home pounded	Hathkuta chawal	8.5	6.80	0.6	0.7	78	0.01	0.17	2.8	351	4	60	Poor	... 100
Rice, parboiled home pounded	Usana hathkuta chawal	8.5	6.60	0.6	0.9	77.4	0.01	0.28	2.8	349	15	90	...	... 99
Rice, rawmilled	Mill kuta chawal	6.9	5.52	0.4	0.5	79.2	0.01	0.11	1.0	348	0	20	Poor	... 99
Rice, parboiled milled	Usna mill kuta chawal	6.4	5.12	0.4	0.8	79.1	0.01	0.15	2.2	346	0	70	Poor	 98
Rice flakes	Poha	6.6	5.28	1.2	1.8	78.2	0.02	0.22	8.0	350	...	70	Poor	 99
Rice, puffed	Murmura	7.5	6	0.1	3.4	74.3	0.02	0.16	6.2	328	...	70	Poor	 98
[1] Rice, raw, unmilled (Prepared in wooden grinder)	Bagad	7.2	...	2.3	1.3	75.1	0.01	0.23	4.5	350	...	95	...	 99
[2] Rice, raw home pounded	Hathkuta chawal	6.8	5.44	1.4	1.1	76.2	0.01	0.21	3.6	345	...	80	...	 98
[3] Rice, raw, milled	Mill kuta chawal	6.7	5.36	0.7	0.8	77.1	0.01	0.16	1.9	343	...	30	...	 97

[illegible] water, allowed to settle over night, supernatant liquid decanted and residue analysed. [illegible] An example [illegible] parboiled [illegible] from the same sample of paddy.
[illegible] vitamin B1 while milled grains are largely deprived of this vitamin.
[illegible] vitamin B1 after [illegible]

PULSES

Name of Foodstuff	Hindi Name	Protein Content %	Biological value of Protein Content %	Fat %	Mineral Matter %	Carbohydrates %	Calcium %	Phosphorus %	Iron Mgs. %	Calorific value per 100 gms.	Carotene International Vitamin A Units per 100 gms.	Vitamin B1 International Units per 100 gms.	Vitamin B2	Vitamin C*. Mgs. per 100 gms.	Calories per oz.
Bengal gram (with outer husks)	Chana	17.1	13	5.3	2.7	61.2	0.19	.24	9.8	361	316	100	....	...	103
Bengal gram roasted (without outer husk)	Bhuna Chana	22.5	17.10	5.2	2.2	58.9	0.07	.31	8.9	372	—	....	...	...	106
Black gram (without outer husk)	Urd	24.0	15.36	1.4	3.4	60.3	0.20	.37	9.8	350	64	140	+ +	....	99
Bhatmas	Bhatwans	41.3	...	17.0	4.5	24.1	0.21	.60	9.9	415	....	....	....	....	118
Cow gram	Lobia bada	24.6	...	.7	3.2	55.7	0.07	.49	3.8	327	....	60	+ +	....	93
Green gram (with outer husk)	Mung	24.0	12.24	1.3	3.6	56.6	0.14	.28	8.4	334	158	155	+ +	—	95
Red gram (without outer husk)	Arhar	22.3	16.54	1.7	3.6	57.2	0.14	.26	8.8	333	220	150	+ +	...	95
Horse gram	Kulthi	22.0	12.98	0.5	3.1	57.3	0.28	.39	7.6	322	119	....	...	....	91
Field bean dry	Val	24.9	18.00	0.8	3.2	60.1	0.06	.45	2.0	347	Trace	....	None	....	99

entil	Masur	25.1	10.29	0.7	2.1	59.7	0.13	.25	2.0	346	450	150	+	....	98
ag, dried	Bada matar	19.7	....	1.1	2.1	56.6	0.07	.30	4.4	315	....	150	....	....	89
as, roasted	Bhuna matar	22.9	....	1.4	2.3	63.5	0.03	.36	5.0	358	....	....	....	....	102
oya beans	Soya bean	43.2	23.32	19.5	4.6	20.9	0.24	.69	11.5	432	710	300	+ +	....	123

*Sprouted pulses contain 10 to 15 mgs. of Vitamin C per 100 gms.

LEAFY VEGETABLES

gathi	Agasthi	8.4	....	1.4	3.1	11.8	1.13	0.08	3.9	93	9,000	....	....	....	26
marnath, tender	Lal choalai	4.9	3.60	0.5	3.1	5.7	0.50	0.10	21.4	47	2,500 to 11,000	10	+	173	13
,, spined	Kantewali choalai	3.0	....	0.3	3.6	8.1	0.80	0.05	22.9	47	....	....	....	....	13
mboo, tender shoots	Bans	3.9	....	0.1	1.4	7.5	0.02	0.09	0.1	47	Trace	....	....	....	13
engal gram leaves	Sag chana	7.0	....	1.4	2.1	11.7	0.34	0.12	23.8	87	....	....	....	....	25
Cabbage	Band gobhi	.81	1.4	0.1	0.6	6.3	0.03	0.05	0.8	33	2000	50	....	124	9
Carrot leaves	Sag gajar	5.1	....	.5	2.8	8.3	0.34	0.11	8.8	58	....	....	....	....	16
Celery	Ajwanka patta	6.0	....	.6	2.1	8.6	0.23	0.14	6.3	64	5,800 to 7,500	Trace	....	62	18
Coriander	Dhania	3.3	....	0.6	1.7	6.5	0.14	0.06	10.0	45	10,460 to 12,600	....	+ +	135	13
Curry leaves	Gandhela	6.1	....	1.0	4.2	16.0	0.81	0.06	3.1	97	12,600	....	+ +	4	38
Fenugreek	Sowa	6.7	3.75	1.7	2.3	13.1	0.44	0.07	7.0	96	11,300	70	....	230	27
Lettuce	Salad	4.9	....	0.2	1.5	9.3	0.17	0.05	16.9	67	3,930	70	....	....	19

LEAFY VEGETABLES—*(Contd.)*

Name of Foodstuff	Hindi Name	Protein Content %	Biological value of Protein Content%	Fat %	Mineral Matter %	Carbohydrates %	Calcium %	Phosphorus %	Iron Mgs. %	Calorific value per 100 gms.	Carotene International Vitamin A Units per 100 gms.	Vitamin B 1 International Units per 100 gms	Vitamin B2	Vitamin C Mg. per 100 gms.	Calories per oz.
Khesari leaves	Kesari sag	6.1	....	1.0	1.1	7.6	0.16	0.10	7.3	64	6,000	....	....	....	18
Lettuce	Salad	2.1	....	.3	2.2	3.0	.05	.03	2.4	23	2,200	90	....	15	7
Mint	Paudina	4.8	....	.6	1.6	8	.20	.08	15.6	57	2,700	....	....	....	16
Neem, tender	Nim patti	11.6	....	3.0	2.6	21.2	.13	.19	25.3	158	4,600	....	....	....	45
Parsley	....	5.9	....	1.0	3.2	19.7	.39	.20	17.9	111	3,200	....	....	281	32
Rape leaves	Sarso sag	5.1	....	.4	2.5	7.1	.37	.11	12.5	52	....	....	....	....	15
Safflower leaves	Sag kardi	3.3	....	.7	1.0	5.1	.18	.06	7.6	40	5,500	....	....	....	11
Spinach	Palak	1.9	....	.9	1.5	4.0	.06	.01	5.0	32	2,600, to 3,500	70	....	48	9

ROOTS AND TUBERS

Beet root	Chugander	1.7	....	.1	.8	13.6	.20	.06	1.0	62	Trace	70	....	88	18
Carrot	Gajar	0.9	....	.1	1.1	10.7	.08	.03	1.5	47	2,000, to 4,300	60	....	3	13
Onion	Pyaj	1.8	....	.1	.6	13.2	.04	.06	1.2	61	25	40	....	11	17
Parsnip	....	1.3	....	.3	1.1	23.2	.05	.04	.4	101	30	105	....	16	29
Potato	Alu	1.6	....	.1	.6	22.9	.01	.03	.7	99	40	20	++	17	28

Sweet potato	Sakarkand	1.2	....	.3	1.0	31.	.02	.05	.8	132	10	....	++	24	37
Raddish (pink)	Muli lal	.6	....	.9	.3	7.4	.5	.02	.5	35	3	60	....	17	10
„ (white)	Muli safed	.7	....	.1	.6	4.2	.05	.03	.4	21	3	....	....	15	6
Tapioca	Maravali or Simla alu	.7	....	.2	1.0	38.7	.05	.04	.9	159	....	15	....	....	45
Yam (elephant)	Jaminkand	1.2	....	.1	.8	18.4	.05	.02	.6	79	434	20	....	Trace	22
Yam (ordinary)	Ratalu, Suran	1.4	....	.1	1.6	27.0	.06	.02	1.3	115	....	24	....	Trace	33

OTHER VEGETABLES

Ash gourd	Petha	.4	....	.1	.3	3.2	.03	.02	.5	15	Trace	21	....	1	4
Bitter gourd	Karela	1.6	....	.2	.8	4.2	.02	.07	2.2	25	210	24	Poor	88	7
„ (small)	„	2.9	....	1.0	1.4	9.8	.05	.14	9.4	60	210	24	....	88	17
Brinjal	Baingan	1.3	....	.3	.5	6.4	.02	.06	1.3	34	5	15	+	23	10
Calabash															
Cucumber	Lowki	.2	....	.1	.5	2.9	.02	.01	.7	13	Trace	....	....	....	4
Cauliflower	Fulgobi	3.5	....	.4	1.4	5.3	.03	.06	1.3	39	38	110	....	66	11
Cluster beans	Gwar ki phali	3.7	....	.2	1.4	9.9	.13	.05	5.8	56	330	....	....	49	16
Cucumber	Kakri	.4	....	.1	.3	2.8	.01	.03	1.5	14	Trace	30	....	7	4
Drumstick	Sajjan	2.5	....	.1	2.0	3.7	.03	.11	5.3	26	184	....	....	120	7
French beans	Pakla	1.7	....	.1	.5	4.5	.05	.03	1.7	26	221	26	....	14	7
Jack, tender	Katl al	2.6	....	.3	.9	9.4	.03	.04	1.7	51	....	....	....	....	14
Kandar Kakdi	Kateli	3.1	....	.8	1.6	4.8	.10	.09	1.2	39	....	....	....	....	1

OTHER VEGETABLES—*(Contd.)*

Name of Foodstuff	Hindi Name	Protein Content %	Biological value of Protein Content%	Fat %	Mineral Matter %	Carbohydrates %	Calcium %	Phosphorus %	Iron Mgs. %	Calorific value per 100 gms.	Carotene International Vitamin A Units per 100 gms.	Vitamin B 1 International Units per 100 gms	Vitamin B2	Vitamin C Mg. per 100 gms.	Calories per oz.
Kovai fruit tender	Kundru	1.2	....	.1	.5	3.5	.04	.03	1.4	20	260	....	....	28	6
Knol khol	Khol rabi	1.1	....	.2	.7	5.9	.02	.04	.4	30	36	85	....	....	9
Ladies fingers	Bhendi	2.2	....	.2	.7	7.7	.09	.08	1.5	41	58	21	+	16	12
Leeks	Vilayathi lasson	1.8	....	.1	.7	17.2	.05	.07	2.3	77	30	75	....	11	22
Mango green	Kairi, Am	.7	....	.1	.4	8.8	.01	.02	4.5	39	150	....	....	3	11
Amla	Amla	.5	....	.1	.7	14.1	.05	.02	1.2	59	....	....	....	600	17
Parwar	Parwar	2.0	....	.3	.5	1.9	.03	.04	1.7	18	....	....	....	....	5
Peas (English)	Mattar	7.2	....	.1	.8	19.8	.02	.08	1.5	109	139	120	....	9	31
Pink beans	Babri	2.4	....	.2	.6	6.2	.40	.04	1.2	36	....	....	....	28	10
Plantain flower	Kele ka ful	1.5	....	.2	1.2	5.0	.03	.05	.1	28	....	....	....	....	8
Plantain green	Kela kacha	1.4	....	.2	.5	14.7	.01	.03	.6	66	50	15	+ +	24	19
Pumpkin	Kaddu	1.4	....	.1	.6	5.3	.01	.03	.7	28	84	200	....	2	8
Ridge gourd	Torai	.5	....	.1	.3	3.7	.04	.04	1.6	18	56	22	....	....	5
Singara (water chest nut)	Singara	4.7	....	.3	1.1	23.9	0.2	.15	.8	117	20	....	....	....	33

Snake gourd	Chachinda	.5	....	.3	.7	4.4	.05	.02	1.3	22	160	....	....	Trace	6
Tomato green	Vilayathi baingan	1.9	....	.1	.7	4.5	.02	.04	2.4	27	320	23	....	31	8
Turnip	Salgam	.5	....	.2	.6	7.6	.03	.04	.4	34	Trace	40	....	43	10
Vegetable marrow	Safed kaddu	.5	....	.1	0.3	4.3	.01	.03	0.6	20	Trace	....	....	18	6

NUTS AND OILSEEDS

Almond	Badam	20.8	....	58.9	2.9	10.5	.23	.49	3.5	655	Trace	80	....	0	186
Cashewnut	Kajoo	21.2	15.86	46.9	2.4	22.3	.05	.45	5.0	596	100	....	+	0	169
Coconut	Narial	4.5	2.61	41.6	1.0	13.0	.01	.24	1.7	444	Trace	15	Poor	1	126
Gingelly	Til	81.3	12.25	43.3	5.2	25.2	1.45	.57	10.5	564	100	....	....	0	160
Groundnut	Mungfali	26.7	15.48	40.1	1.9	20.3	.05	.39	1.6	549	63	300	+	0	156
Groundnut roasted	Bhuni mungfali	31.5	....	39.8	2.3	19.3	.05	.44	.3	561	....	....	....	0	159
Linseed	Alsi	20.3	....	37.1	2.4	28.8	.17	.37	2.7	530	50	....	....	0	151
Mustard seeds	Rai	22.0	....	39.7	4.2	23.8	.49	.7	17.9	541	270	....	....	Trace	151
Pistachio nut	Pista	19.8	....	53.5	2.8	16.2	.14	.43	[illegible]	625	240	....	....	0	178
Walnut	Akrot	15.6	....	64.5	1.8	11.0	.10	.38	4.8	687	10	130	....	0	193

[illegible] are in general devoid of carotene and Vitamin A. Red palm oil is an exception. [illegible] per 100 gms.

CONDIMENTS, SPICES, ETC.

Name of Foodstuff	Hindi Name	Protein Content %	Biological value of Protein Content %	Fat %	Mineral Matter %	Carbohydrates %	Calcium %	Phosphorus %	Iron Mgs. %	Calorific value per 100 gms.	Carotene International Vitamin A Units per 100 gms.	Vitamin B1 International Units per 100 gms.	Vitamin B2	Vitamin C. Mgs. per 100 gms.	Calories per oz.
Asafoeteda	Hing	4.0	....	1.1	7.0	67.8	.69	.05	22.2	297	....	...	....	0	84
Cardamom	Elaychi	10.2	...	2.2	5.4	42.1	.13	.16	5.0	229	....	....	....	0	65
Chillies green	Hara mirch	2.9	....	.6	1.0	61.1	.03	.08	1.2	41	454	....	....	111	12
Chillies dry	Lal mirch	15.9	....	6.2	6.1	31.6	.16	.37	2.3	246	576	....	....	50	70
Cloves	Loung	5.2	...	8.9	5.2	47.9	.74	.10	4.9	293	....	....	....	0	83
Coriander	Dhania	14.1	...	16.1	4.4	21.6	.63	.37	17.9	288	1570	....	....	Trace	82
Cumin	Zira	18.7	...	15.0	5.8	36.6	1.08	.49	31.0	356	870	....	....	3	101
Fenugreek seeds	Methi	26.2	....	5.8	3.0	44.1	.16	.37	14.1	323	160	....	...	0	95
Garlic	Lehsun	6.3	...	.1	1.0	29.0	0.3	.31	1.3	142	0	....	....	13	40
Ginger	Adrak	2.3	....	.9	1.2	12.3	0.2	.06	2.6	67	67	....	....	6	19
"Kandanthippli"	....	6.4	...	2.3	4.8	65.8	1.23	.19	62.1	310	...	....	...	0	88
Lime-peel	....	1.8	...	.5	1.8	29.4	.71	.06	2.7	129	...	...	...	....	37
Mace	Javitri	6.5	...	24.4	1.6	47.8	.18	.10	12.6	437	...	...	....	0	124
Nutmeg	Jaiphal	7.5	...	36.4	1.7	28.5	.12	.24	4.6	472	Trace	...	...	0	134
Omum	Ajvan	15.4	...	18.1	7.1	38.6	1.42	.30	14.6	379	...	...	...	...	108
Pepper green	Kali mirch (kacha)	4.8	....	2.7	1.8	27.3	.27	.07	2.4	153	680	...	...	...	43

Pepper dry	"	11.5	....	6.8	4.4	49.5	.46	.20	16.8	305	...	...	...	....	87
Tamarind pulp	Imli	3.1	....	.1	2.9	67.4	.17	.11	10.9	283	100	...	....	3	82
Turmeric	Huldi	6.3	....	5.1	3.5	69.4	.15	.28	18.6	349	50	...	....	0	99

FRUITS

Apple	Seb	0.3	....	.1	.3	13.4	.01	.02	1.7	56	Trace	40	....	2	16
Banana	Kela	1.3	....	.2	.7	36.4	.01	.05	0.4	153	...	Trace	50	1	43
Bilimbi	Kamrak	.5	....	.2	.2	4.8	.01	.01	.6	23	240	...	....	....	7
Cape gooseberry	Rasbary	1.8	....	.2	.6	11.5	.01	.06	1.8	55	...	...	...	49	16
Cashew fruit	Kaju ka phal	.2	....	.1	.2	11.6	.01	.01	0.2	48	....	...	...	...	14
Date (Persian)	Khajur	3.0	....	.2	1.3	67.3	.07	.08	10.6	283	600	30	+	Trace	80
Figs	Anjeer	1.3	....	.2	.6	17.1	.06	.03	1.2	75	270	....	...	2	21
Grapes blue variety	Angur	.8	....	.1	.4	10.2	.03	.02	.4	45	15	Trace	...	3	13
Grape fruit		1.0	....	.1	.4	10	.03	.03	.2	45	....	40	...	Juice 41	13
Phalsa [illegible]	[illegible]	1.5	....	.2	.8	14.5	.01	.04	1.0	66	Trace	....	...	290	19
[illegible]	[illegible]	1.0	....	.1	.5	13.9	.02	.03	.5	84	540	....	...	10	4
[illegible]	[illegible]	.7	....	.1	.1	12.7	.02	.01	1.0	53	...	....	...	...	34

FRUITS—*(Contd.)*

Name of Foodstuff	Hindi Name	Protein Content %	Biological value of Protein Content%	Fat %	Mineral Matter %	Carbohydrates %	Calcium %	Phosphorus %	Iron Mgs. %	Calorific value per 100 gms.	Carotene International Vitamin A Units per 100 gms.	Vitamin B 1 International Units per 100 gms	Vitamin B2	Vitamin C Mg. per 100 gms.	Calories per oz.
Karwand dry	Karwand	2.3	....	9.6	2.8	67.1	.16	.06	39.1	364	...	....	....	...	103
Korukkapalli	Manilaimli	2.6	....	.3	.4	15.9	.01	.04	.4	77	...	...	....	....	22
Lemon	Meetha neembu	1.0	....	.9	.3	11.1	.07	.01	2.3	57	Trace	...	...	Juice 39	16
Lime	Neembu	1.5	....	1.0	.7	10.9	.09	.02	.3	59	26	...	....	Juice 63	17
Mango (ripe)	Am	.6	....	.1	.3	11.8	.01	.02	.3	50	4,800	....	Poor	13	14
Melon, water	Tarbuz	.1	....	.2	.2	3.8	.01	.01	.2	17	Trace	....	....	1	5
Orange	Santra	.9	....	.3	.4	10.6	.05	.02	.1	49	350	40	....	68	14
Palmyra fruit (tender)	Tar	.6	....	.1	0.2	6.5	.01	.02	.5	28	....	...	....	4	8
Papaya, ripe	Papita	.5	....	.1	.4	9.5	.01	.01	.4	40	2,020	....	....	46	11
Peaches	Arhu	1.5	....	.2	.6	7.6	.01	.03	1.7	38	Trace	....	....	1	11
Pears	Naspati	.2	....	.1	.3	11.5	.01	.01	.7	47	14	....	....	Trace	13
Pine apple	Ananas	.6	....	.1	.5	12.0	.02	.01	.9	50	60	....	....	63	14
Plantain (red variety)	Lal kela	1.6	....	.1	.8	23.4	.01	.02	.6	101	350	....	....	....	29
Plums (red variety)	Jardalu	.7	....	.2	.4	8.9	.02	.02	.5	40	230	....	....	1	11

omegranate	Anar	1.6	....	.1	.7	14.6	.01	.07	.3	65	0	....	....	16	18
omeloe	Chakutra	.6	....	.1	.5	10.2	.03	.03	.1	44	200	...	....	20	12
aisins	Khismis	2.0	....	.2	2.0	77.3	.10	.08	4.0	319	0	75	....Trace		91
traw berry	Staberry	.7	....	.2	.4	9.8	.03	.03	1.8	44	....	....	....	52	12
omato, ripe	Tamata	1.0	....	.1	.5	3.9	.01	.02	.1	21	320	40	....	32	6
Vood apple	Kaith	7.3	....	.6	1.9	15.5	.13	.11	.6	97	....	....	....	....	28
izyphus	Ber	.8	....	.1	.4	12.8	.03	.03	.8	55	70	....	....	....	16

FLESH FOODS

											Vit. A	Carotene				
eef	Gai ka gosht	22.6	22.0	2.6	1.0	....	0.1	.19	.8	114	59	Trace	50	....	2	32
gg, duck	Batakh ka anda	13.5	12.7	13.7	1.0	.7	.07	.26	3.0	180	1200	900	....	....	....	51
gg, fowl	Murgi ka anda	13.3	....	13.3	1.0	....	.06	.22	2.1	173	1200	1000	....	....	....	49
ish	Machli	22.6	....	.6	.8	....	.02	.19	.9	91	26	9	....	....	...	26
eep liver	Kaleja (Bher)	19.3	....	7.5	1.5	1.4	.01	.38	6.3	150	22,300	0	120	....	20	43
Iutton	Bakri ka gosht	18.5	....	13.3	1.3	...	.15	.15	2.5	194	31	Trace	60	....	....	55
Iutton fat		.34	....	26.4	....	...	....	....	....	900	....		....	...	...	239
ork	Suar ka gosht	18.7	....	4.4	1.0	...	.03	.2	2.3	114	Trace	Trace	180	...	2	32

MILK AND MILK PRODUCTS

[illegible]	Gai ka dudh	3.3	2.7	3.6	.7	4.8	.12	.09	.2	65	180	Trace	17	4	4	2	18
[illegible]	[illegible] ka dudh	4.1	3.6	3.3	.8	5.1	.21	.13	.2	117	162	Trace	...	...	...	...	33
[illegible]	Bakri ka dudh	3.7	3.1	5.6	.8	4.7	.17	.13	.3	84	13.2	Trace	...	...	...	...	21

MILK AND MILK PRODUCTS—(*Contd.*)

Name of Foodstuff	Hindi Name	Protein Content %	Biological value of Protein Content %	Fat %	Mineral Matter %	Carbohydrates %	Calcium %	Phosphorus %	Iron Mgs. %	Calorific value per 100 gms.	Carotene International Vitamin A Units per 100 gms.	Carotene	Vitamin B1 International Units per 100 gms.	Vitamin B2	Vitamin C. Mgs. per 100 gms.	Calories per oz.
Milk, human	Aurat ka dudh	1.0	....	3.9	.1	7.0	.02	.01	.2	67	208	Trace	....	...	0	19
Curds	Dahi	2.9	...	2.9	.6	3.3	.12	.09	.3	51	130	Trace	....	....	...	14
Butter	Makhkhan	...	....	80.8	....	....				730	600 to 6,000	....		+ Vit. D*		
Ghee, cow's	Gai ka ghee	...	....	98.0	....	....				900	1,000 to 2,500	....		+		
Ghee, buffalo's	Bhains ka ghee	...	...	98.0	....	....				900	500			+		
Butter milk	Chhachh	.8	...	1.1	.1	.5	.03	.03	.8	15	Trace		0	....	....	4
Skimmed milk	...	2.5	....	.1	.7	4.6	.12	.09	.2	29	....		....	....	1	8
Skimmed milk powdered	...	38.0	....	.1	6.8	51.0	1.37	1.0	1.4	357	0	0	19	...	....	101
Cheese	Panir	24.1	....	25.1	4.2	6.3	.79	.52	2.1	348	273		....	....	....	99
Koa (whole buffalo milk)	Koa	14.6	....	31.2	3.1	20.5	.65	.42	5.8	421	....		....	....	....	120
Koa (skimmed buffalo milk)		22.3	...	1.6	4.3	25.7	.99	.65	2.7	206	....		....	....	0	59

SUGARS AND STARCHES*

		Moisture							Total sugar present as		
									Cane sugar		Glucose and fructose
Cane sugar, refined	Chini	...	...	....	.02	....		...	.04	99.7	Nil
Cane gur	Ganne ka gur	3.5	...	.17	.74	90.6	.064	.056	2.5 365.3	8.14	... ...
Coconut palm gur	Nariel ka gur	.96	...	.15	5.04	83.53	1.638	.062	....	10.32	71.89 3.70
Date palm gur		1.46	....	.26	2.6	86.7	.363	.062	....	9.16	72.01 1.48
Palmyra palm gur	Tad ka gur	1.3	....	.08	1.81	88.47	.225	.044	....	8.61	79.92 1.98
Sago palm gur	Madi ka gur	2.28	....	.11	3.66	84.89	1.352	.372	....	9.16	84.31 .53
Coconut sweet toddy	Nariel ka nira	.1	....	.17	.66	14.35	.149	.011	.26 59.3.3	59.33	....
Palmyra sweet toddy	Tad ka nira	.23	....	.02	.29	13.52	.006	.007	.... 36.6	85.94	....

MISCELLANEOUS FOOD STUFFS

Arrow root	Arrow root	.2	....	.3	.1	83.1	.01	.02	1.0 334	...	....	...	...	95
[illegible]	Pan	.31	....	.8	2.3	6.1	.23	.04	5.7 44	0,635	....	...	5	12
[illegible]		...	...	106	....	....	....	....	 900	60,000to200,000				256
[illegible]		...	...	106	....	....	....	....	 900	30,00000				256
[illegible]		...	...	106	....	....	....	....	 900			40,000to57,000		256

[illegible] Public Health Laboratory

APPENDIX II

THREE DEFICIENCY DISEASES

Beri-Beri

This is a disease found especially among persons eating polished rice. It is more marked in regions where the staple diet of the people is only rice. Even among wheat eaters those who use only white flour are found to suffer from it. Anti-beriberi Vitamin B_1 is found in the outer layers and germs of the grain, but not in the starchy endosperm. Polishing rice or producing white flour from wheat removes both the outer layers and the germ of the grains and also Vitamin B_1 with them.

Vitamin B_1 being water soluble is also lost if rice is washed repeatedly before cooking or if the extra water in which rice is cooked is drained off and thrown away. It is Vitamin B_1 that keeps the muscles and the nerves of the body strong and in good tone. That is to say, it is Vitamin B_1 that makes the respiratory, digestive, circulatory, excretary and nervous systems function in a proper way. In the absence of Vitamin B_1 the muscles of the organs of these systems become loose. That is what Beriberi means. Beriberi is a sinhalese expression meaning, "I cannot". That is, the person affected by it is too ill to do anything. All the limbs, especially of the lower part of the body, are atrophied. The heart becomes weak and sometimes fails. It is a disease which takes a heavy toll of people eating mainly polished rice. Children born of, or fed by mothers taking a diet deficient in Vitamin B_1 die of beriberi. Leaving aside extreme cases of death, Vitamin B_1 dificiency lowers the

working efficiency of all the organs of the body. Since deficiency in Vitamin B_1 impairs the neuro-muscular activity of all the organs of the body, complaints of all kinds are associated with it. Pronounced deficiency of this substance in the dietary of pregnant women exposes them to the risk of abortion, still-birth etc. It has been observed that in South India, where milled rice is the staple food, abortion and still-birth are more common than in northern parts of India, where wheat forms part of the usual diet.

All the same, the disease is preventible and that very easily. Stop consuming polished rice or white flour and you overcome the disease.

The following two tables will make this clear

Beri Beri and Milled Rice

Type of Rice Consumed	Number of persons examined	Number in which Beri Beri occured	Percent	Proportion of cases of Beri Beri among total number of inmates
Half polished	37	1	2.7	1 in 10.
One-third polished	13	6	46.	1 in 4
Polished	51	36	71.	1 in 3

Chemical composition and Vitamin B_1 content of Wheat grain

	Nitrogenous compounds Protein &c Per cent	Starch & Sugar Per cent	Fat Per cent	Mineral salts Per cent	Cellulose Per cent	Water Per cent	Vitamin B_1 Int. Unit Per. Gm.
Whole grain	11.0	69.0	1.2	1.7	2.6	14.5	3
Germ	35.7	31.2	13.1	5.7	1.8	12.5	10
Bran	16.4	43.6	3.5	6.0	18.0	12.5	1.3
Endosperm	10.5	74.3	0.8	0.7	0.7	13.0	0.15.

The Government can put an end to it by banning the production of polished rice or white flour but they do not take any serious steps in this direction for fear of the opposition of the manufacturers.

Keratomalacia

This is an eye disease caused by the deficiency of Vitamin A. Children's eyes are easily affected by this deficiency. The conjuctiva becomes dry, wrinkled and greasy looking, the cornea dull and lustreless and eventually opaque. Later the cornea undergoes ulceration, and if untreated, the ulcer perforates and ultimately the eye is lost. Of all blind persons in our country 4 percents owe their blindness to deficiency of Vitamin A. Chiefly the poor suffer from this. It is a preventible disease and is easily cured by taking enough of cows ghee, milk and other foods rich in Vitamin A.

For fear of indigestion, the cream that [illegible] boiled milk is removed before feeding it to [illegible] cuts off their supply of Vitamins A and D and [illegible] their eyes are affected. It is always good to give [illegible] to children. Skimmed milk, though good in respect of [illegible] food constituents, lacks in Vitamin A and D, which [illegible] important for children. In this respect skimmed [illegible] poor substitute for whole milk. The poor feed their children on the gruel of flour or rice in the place of milk. [illegible] milk to children should be regarded as a social crime.

Rickets

Deficiencies of calcium, phosphorus and Vitamin D have similar effects. The diseases caused relate mainly to the bones. Rickets in childhood and osteomalacia (in [illegible] bones) are the main symptoms.

Rickets are indicated by the late growth of teeth, delayed balancing of the body, and incomplete development of the chest ribs etc. of the child. The last defect affects the full development of the lungs which makes the child liable to frequent attacks of pneumonia. The direct result of rickets is not death, but diseases like pneumonia.

In the tropical climate of India it is more the deficiency of calcium than the deficiency of Vitamin D that is the cause of rickets. The effects of rickets are permanent. Rickets in young girls does not allow the proper development of the abdomen, and therefore results in painful delivery or even death. Special care should, therefore, be taken to prevent rickets to develop in young girls.

Women of advanced age get osteomalacia for want of calcium or Vitamin A. They are not able to walk properly. Their legs become curved and all their limb joints become ache. Women observing purdha are especially subject to this disease.

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